Standard Size, 9 x 12. DECEMBER 28, 1905. Price Ten Cents.

AMERICAN MACHINIST

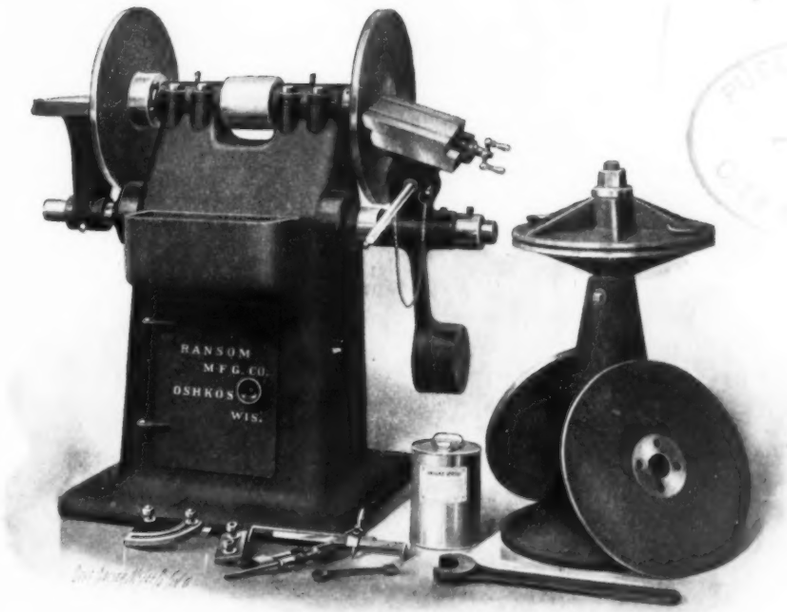
A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

ISSUED WEEKLY BY THE HILL PUBLISHING COMPANY,

Vol. 28. 505 PEARL STREET, NEW YORK. No 52.

Index to Advertisers and Classified Index Following Reading Matter.

DISC GRINDERS



A great money saver in finishing up Drop Forgings, Wrought Iron and Brass. The Discs run 50% faster than an emery wheel, thus removing more metal.

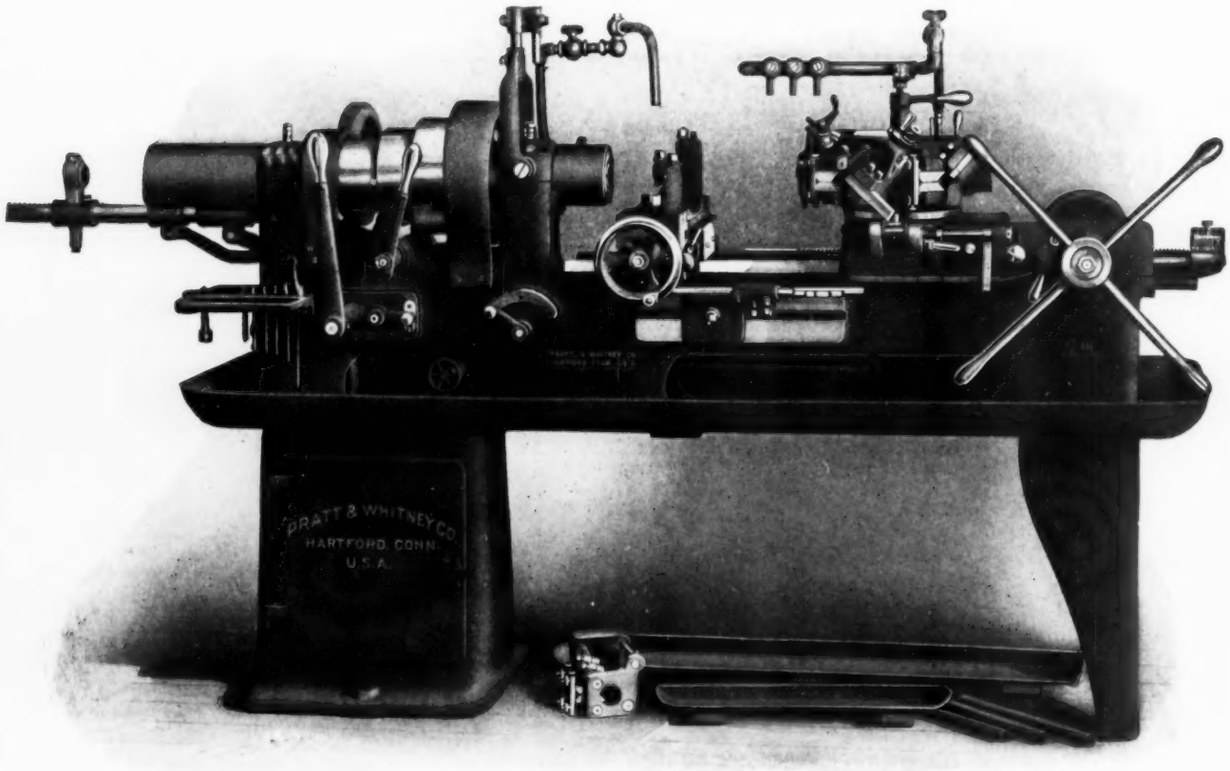
Send us samples of your work to be ground free of charge, and let us demonstrate that this machine will save you money.

RANSOM MANUFACTURING CO.,

OSHKOSH, WIS., U.S.A.

Turret Lathes

FIVE SIZES: $\frac{5}{8}$x4$\frac{1}{2}$, 1x10, 1$\frac{1}{2}$x18, 2x26, 3x36



1½ x 18 inch Pratt & Whitney Turret Lathe

Our ½ x 18 inch Turret Lathe has proven to be a very popular machine. It will take bar work up to 1½ inches diameter and will do its work as rapidly as our 2 inch machine, yet there is a material difference in the first cost of the two machines.

PRATT & WHITNEY COMPANY,
HARTFORD, CONN., U.S.A.

OFFICES—**Trinity Building, 111 Broadway, New York.** Boston: 144 Pearl St. Chicago: 46 South Canal St. Pittsburg: Frick Bldg. St. Louis: 516 North 3d St. Philadelphia: 21st and Callowhill Sts. Agents—The Canadian Fairbanks Co., Ltd., Montreal, Toronto, Winnipeg and Vancouver.

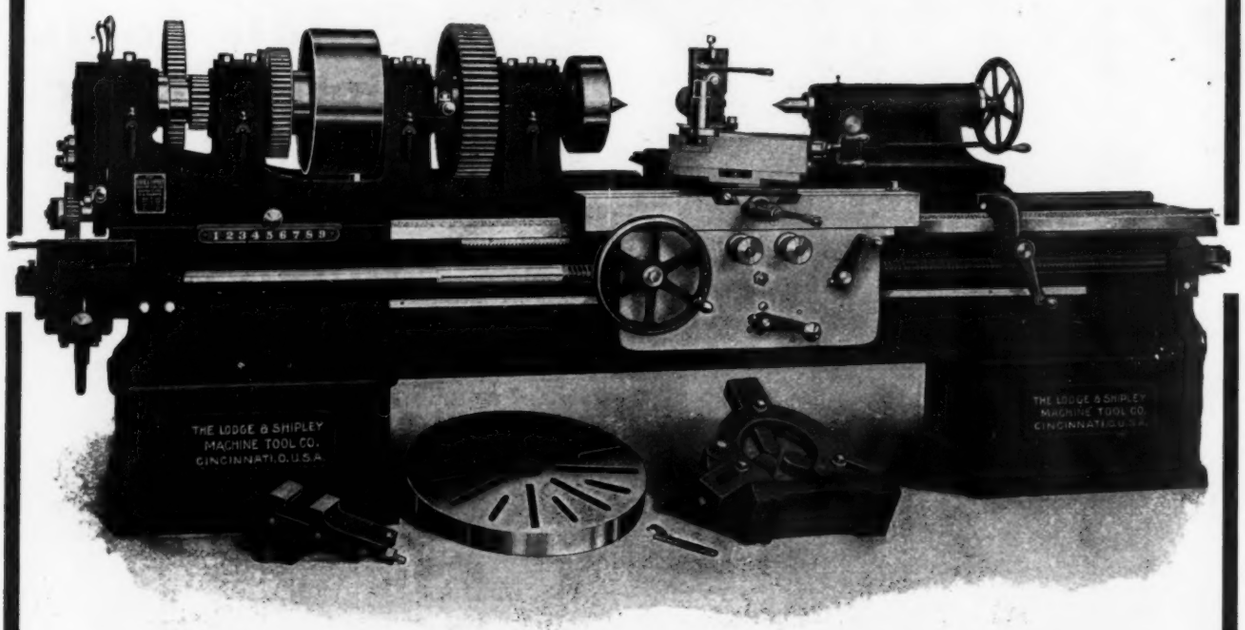
Machinists' Small Tools, Gauges, Etc., Of the Highest Quality.

Send to Hartford, Conn., for Small Tool Catalog.

PRATT & WHITNEY COMPANY,
HARTFORD, CONN., U.S.A.

OFFICES—**Trinity Building, 111 Broadway, New York.** Boston: 144 Pearl St. Chicago: 46 South Canal St. Pittsburg: Frick Bldg. St. Louis: 516 North 3d St. Philadelphia: 21st and Callowhill Sts. Agents—The Canadian Fairbanks Co., Ltd., Montreal, Toronto, Winnipeg and Vancouver.

"More Lathe Work with Fewer Lathes."



24" Patent Head Lathe. 15" Diam. Driving Pulley for 6½" Belt. 18 Speeds, 32 Feeds, 32 Threads.

We Call Your Attention To

The depth and stiffness of the bed, which is of ample width and is strongly braced internally by cross girths.

The extremely heavy and substantial carriage, provided with liberal tee slots milled from the solid and gibbed to the bed its entire length.

The Ledge, a steel strip let into and securely fastened to the front of the bed upon which the back plate of the apron slides. This affords a substantial support upon the bed directly in line with the strains which tend to separate the gears, or the rack and pinion, while under a heavy load.

The Massive Headstock with its ample sleeve and spindle bearings. The large front spindle bearing, which will offer rigid support to spindle on overhanging chuck or face-plate work. The wide-faced gearing, capable of driving a heavy cut at a slow gear speed. The large diameter, wide-faced driving pulley, giving great belt speed and belt contact surface with low spindle speed in bearings. The double back gear, which gives a perfect speed range with 18 changes. The perfect oiling facilities, requiring attention once a month, with glass gauges at the front of each bearing showing height of oil in each oil well, located under bearing. Oil supply, automatic, and by means of ring oilers fastened to revolving spindle.

The Tailstock with the long spindle barrel, the improved method of locking same by thrust plugs, the tailstock pawl that engages with rack cast in center of lathe bed, thus relieving strain on tailstock bolts under heavy cutting conditions.

The quick change feed and thread-cutting arrangement, 32 threads, 32 feeds, without removing a gear, engaged when lathe is running, all steel gearing, rigidly supported on bed—nothing trappy—compact, powerful.

An accurate standard Engine Lathe of wide usefulness with the powerful drive of a rapid reduction lathe and built to stand back of that drive.

Sizes 14" to 48". **Send for our Catalogue R.**

The Lodge & Shipley Machine Tool Co.,

Cincinnati, Ohio.

CANADIAN AGENTS—H. W. Petrie, Toronto, Can. Williams & Wilson, Montreal, Can.

EUROPEAN AGENTS—Adler & Eisenschitz, Milan. C. W. Burton, Griffiths & Co., London. V. Lowener, Copenhagen. R. S. Stokvis & Zonen, Rotterdam. Alfred H. Schutte, Paris, Cologne, Barcelona, Brussels. Schuchardt & Schutte, Berlin, Vienna, St. Petersburg. Werner Hult, Helsingfors.

A Strong Claim for Accuracy.

We make the claim for Bradford Lathes that they will bore true to within one two-thousandths of an inch in 24 inches. Big claim, isn't it?

If you would spend a few days in our plant, playing the role of inspector, and could see for yourself with what care and precision all cylindrical surfaces are ground and flat surfaces scraped, and how, when assembled, all parts are as near perfect in alignment as modern skill can make them, you'd be less inclined to doubt the above claim.

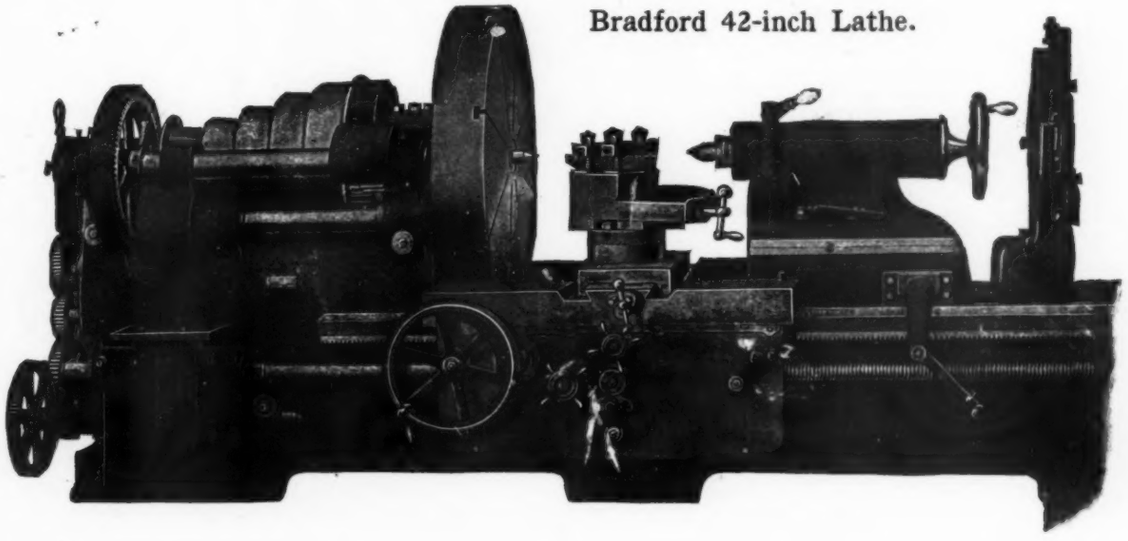
And we are just as careful about making provisions for the thorough lubrication of all wearing surfaces; on cylindrical surfaces oil channels are cut on our coarse screw cutting lathes and not chipped in.

Your own judgment would tell you, upon investigation, that the metal is liberally distributed and in the best possible manner for securing the solidity and strength necessary for the successful working of modern high-speed steels.

You'd find nothing neglected or slighted in the least in the construction of the Bradford Lathes—no weak spots. On the other hand, you'd note that only the best materials are used; that these lathes comprise every modern and approved feature that tends to secure accuracy and economical production.

If you could spare the time to visit our factory, we'd be delighted to point out every detail of construction of our lathes.

Anyhow, send for the catalog and learn the details of our various styles from 14-inch to 42-inch.



Bradford 42-inch Lathe.

The Bradford Machine Tool Co.

Cincinnati, O., U. S. A.

Vandyck Churchill Co., New York and Philadelphia, Eastern Agents. Pacific Tool & Supply Co., San Francisco, Cal., Agents for Pacific Coast.

FOREIGN AGENTS—Chas. Churchill & Co., Ltd., London, Birmingham, Manchester, Glasgow, Newcastle-on-Tyne. Schuchardt & Schutte, Berlin, Vienna, St. Petersburg, Stockholm. Alfred H. Schutte, Cologne, Brussels, Liege, Paris, Milan and Bilbao. F. W. Horne, Japan, China and Far East.

Betts Machine Company,

Wilmington, Del., U.S.A.

Makers of

Heavy Machine Tools

For High Speed Steel.

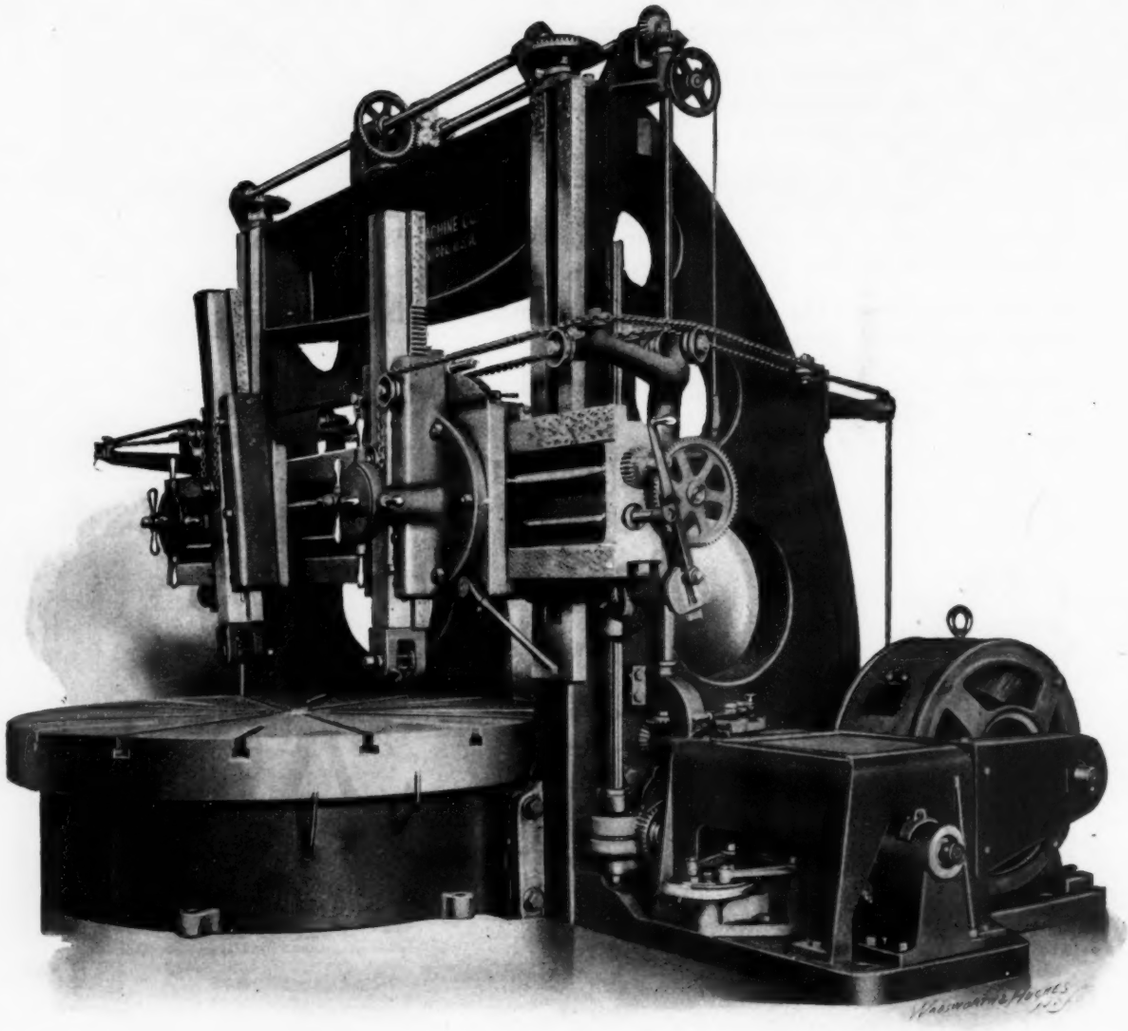
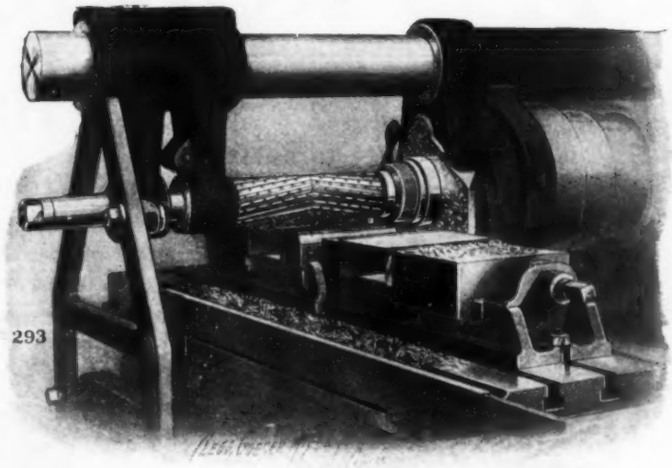


Illustration shows the BETTS Patent Worm-Driven 7 Ft. Boring and Turning Mill, as arranged with Westinghouse Motor Outfit for the "Soo" Line Shops, at Minneapolis, Minn.

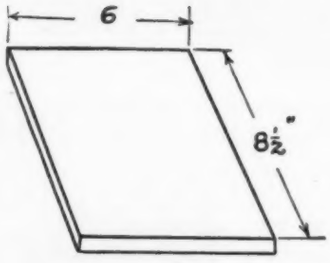
Vertical Boring Mills,
Horizontal Boring Machines,
Planers, Slotters,
Tire Mills, Floor Borers,
Etc., Etc.

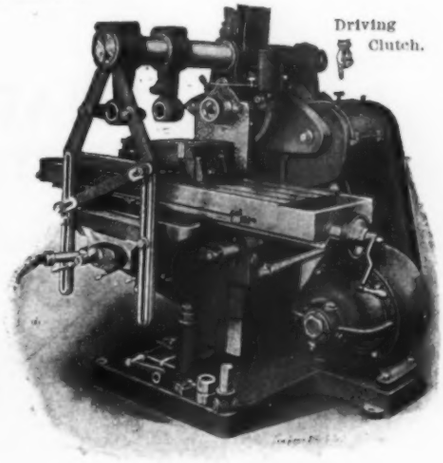
"The Ideal Milling Machine Drive."



No. 4 PLAIN MOTOR-DRIVEN MILLER.

Grey iron castings 8½" wide, cut $\frac{3}{32}$" deep, cutter 4" diam., Novo, 60 r.p.m., feed .250", table travel 15" per minute.





"THE IDEAL DRIVE."

Our No. 4 Plain motor-driven Miller takes a roughing cut across these pieces at a table travel of 15" per minute. The same size machine belt-driven, does it at a table travel of 12" per minute. That's good work for the belt-driven machine, but the motor drive beats it by 25%. It is because the drive is positive, has no slipping belts, and always delivers the maximum power.

It doesn't pay to install belt-driven machines. Let us tell you all about our Motor-Driven Millers.

WE ARE MILLING SPECIALISTS.

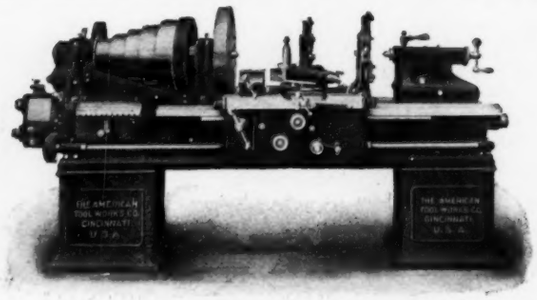
The Cincinnati Milling Machine Co.

Cincinnati, Ohio, U.S.A.

EUROPEAN AGENTS—Schuchardt & Schutte, Berlin, Vienna, St. Petersburg, Stockholm. Alfred H. Schutte, Cologne, Brussels, Liege, Milan, Paris, Turin, Barcelona and Bilbao. Chas. Churchill & Co., London, Birmingham, Manchester, Newcastle-on-Tyne and Glasgow.

CANADIAN AGENTS—Williams & Wilson, Montreal. H. W. Petrie, Toronto.

PROFIT PRODUCERS



LATHES,

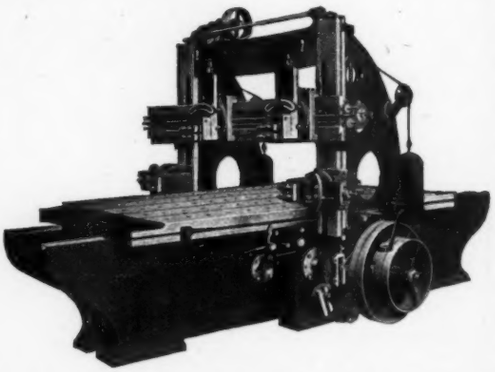
14 in. to 60 in. swing.

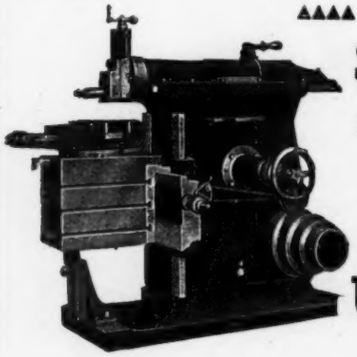
Equipped with Cone Head or our Patented Geared Head, the former recommended for ordinary lathe work, the latter for heavy duty. The geared head lathe produces remarkable results **on certain work to which it is adapted.**

PLANERS,

22 in. to 72 in. between housings.

"American" Planers are strongly proportioned, easy and rapid in operation, exceptionally accurate, and built throughout for high speed planing. Variable speed furnished.



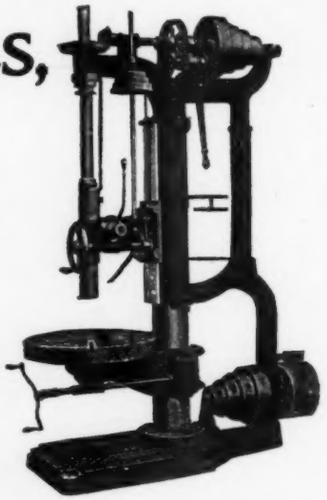


SHAPERS,

16 in. to 28 in. stroke.

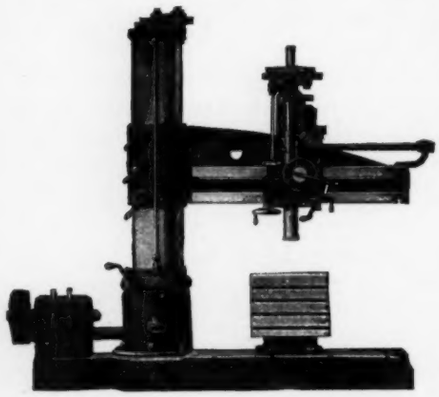
New "American" Shapers—just out—are of the most advanced design, capable of very heavy work at high speeds. Scientifically constructed for resistance of strain, and operated with the minimum of effort.

UPRIGHT DRILLS,



13 in. to 42 in. swing.

"American" Upright Drill Presses are thoroughly modernized and strengthened over former patterns, and capable of continuous hard service under the most progressive methods.



RADIAL DRILLS,

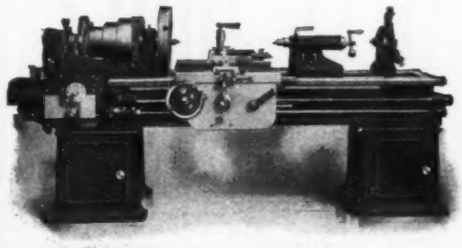
2½ ft. to 7 ft. Arms.

An entirely new line, built for using the limit of efficiency of high speed twist drills. In actual practice they have shown capacity for powerful and rapid drilling, surpassing all known existing records on other makes of Radial Drills.

THE AMERICAN TOOL WORKS CO.

CINCINNATI, U. S. A.

Schumacher & Boye 18″ Patented Instantaneous Change Gear Engine Lathe



With three-step cone and double back gear, permitting of a wide belt and high velocity for high cutting speeds. Workmanship and material of the highest standard. We invite your closest inspection.

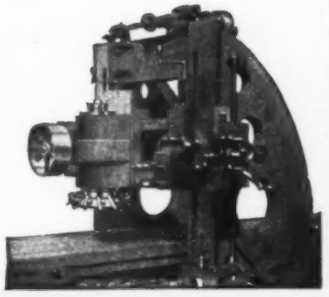
Schumacher & Boye, ENGINE LATHES, 18″ to 48″ Swing, **Cincinnati, Ohio, U.S.A.**

MILLING ON THE PLANER

You have a stationary tool on your planer, why not have a revolving tool, also?

***The* Farwell Miller, Built for planers, is a big cost cutter on a lot of that work that is finished all over.**

Vertical, horizontal or angular spindle. Four sizes.
We can fit any planer. Send for Catalog No. 55.



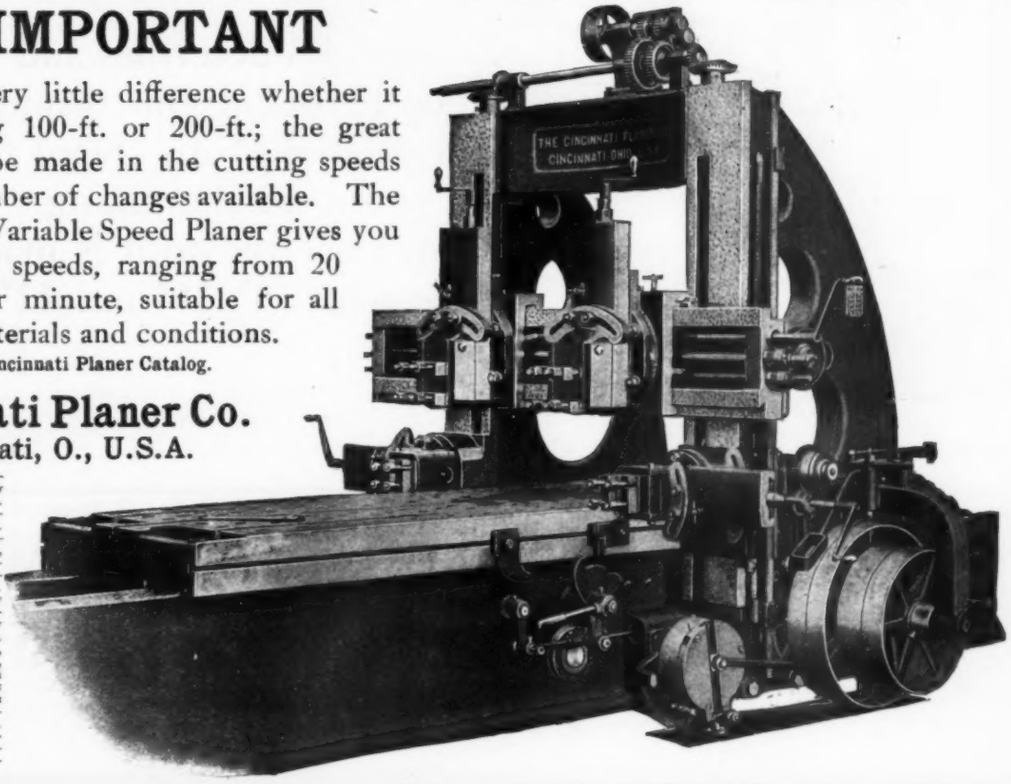
THE ADAMS COMPANY,
DUBUQUE, IOWA, U.S.A.

De Fries & Co., Dusseldorf, Germany. J. Lambercier & Co., Geneva, Switzerland. V. Lowener, Copenhagen, Denmark. G. Koeppen & Co., Moscow, Russia.

THE RETURN TO A PLANER TABLE IS NOT IMPORTANT

It makes very little difference whether it is returning 100-ft. or 200-ft.; the great gain is to be made in the cutting speeds and the number of changes available. The Cincinnati Variable Speed Planer gives you four cutting speeds, ranging from 20 to 60-ft. per minute, suitable for all kinds of materials and conditions.

Ask for a Cincinnati Planer Catalog.



Cincinnati Planer Co.
Cincinnati, O., U.S.A.

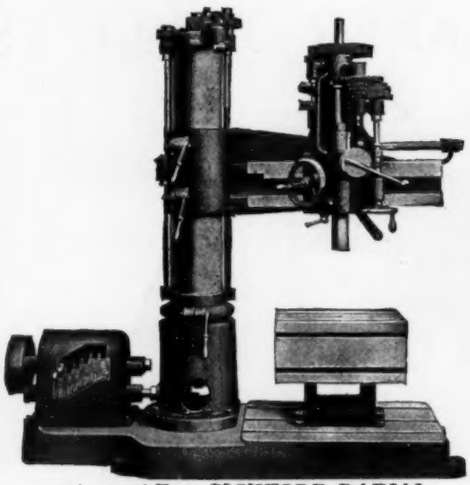
DOMESTIC AGENTS—Prentiss Tool & Supply Co., New York, Boston and Buffalo. Marshall & Huschart Machinery Co., Chicago. Motch & Merryweather Machinery Co., Cleveland, Ohio. W. K. Shipley, Philadelphia, Pa. Baird Machinery Co., Pittsburg, Pa. W. R. Colcord Machinery Co., St. Louis, Mo. McArdle-Parker Machinery Co., New Orleans and Birmingham. Scott Supply and Tool Co., Denver, Colo. Harron, Rickard & McCone, San Francisco, Cal. FOREIGN AGENTS—Ludw. Loewe & Co., Berlin. Vaghi Accornero & Co., Milano. E. S. Stokvis & Zonen, Rotterdam, Holland. J. Lambercier & Co., Geneva, Switzerland.

2½, 3 and 3½-FOOT RADIAL DRILL

Peculiarly Adapted for Light and Medium Manufacture

Has 12 changes of speed with the gear drive and 10 changes with the cone drive, which, by being confined to the comparatively narrow limits of approximately seven to one, are suitable for drilling economically all work adapted to the capacity of the machine.

All of the operating levers can be manipulated from a central position in front of the machine, the operator not having to change his position when making speed or feed changes or in engaging or disengaging the back gears.



2½, 3, 3½-Foot BICKFORD RADIAL

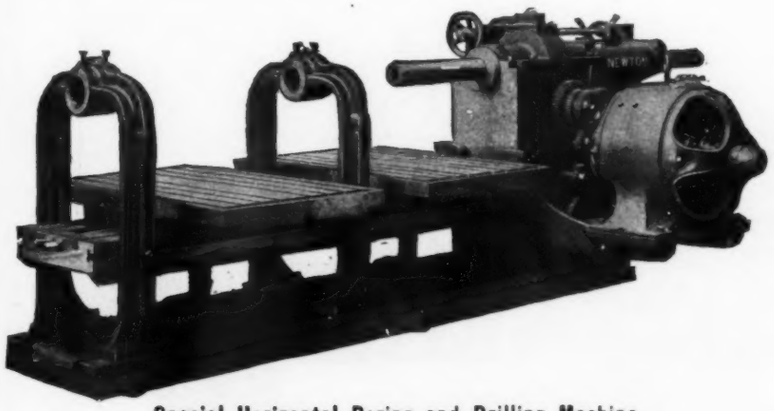
Circular 1A describes and illustrates in detail this wonderful little Radial Drill. Send for it. It's yours for the asking.

Remember the tool is made in three sizes 30", 36" and 42" arm.

THE BICKFORD DRILL & TOOL COMPANY,

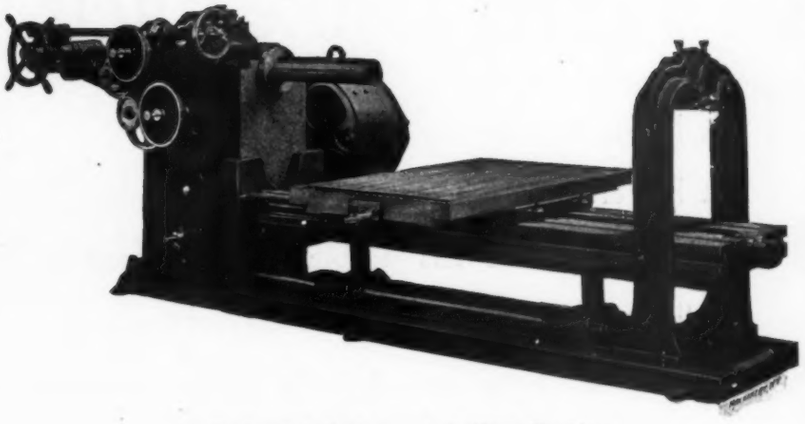
Cincinnati, Ohio, U. S. A.

Foreign Agents: Schuchardt & Schutte, Berlin, Vienna, Stockholm, St. Petersburg, New York. Alfred H. Schutte, Cologne, Brussels, Liege, Paris, Milan, Bilbao, Barcelona, New York. Chas. Churchill & Co., Ltd., London, Birmingham, Manchester, Newcastle-on-Tyne and Glasgow. H. W. Petrie, Toronto, Canada. Williams & Wilson, Montreal, Canada.



Special Horizontal Boring and Drilling Machine

NEWTON



Horizontal Boring and Drilling Machine

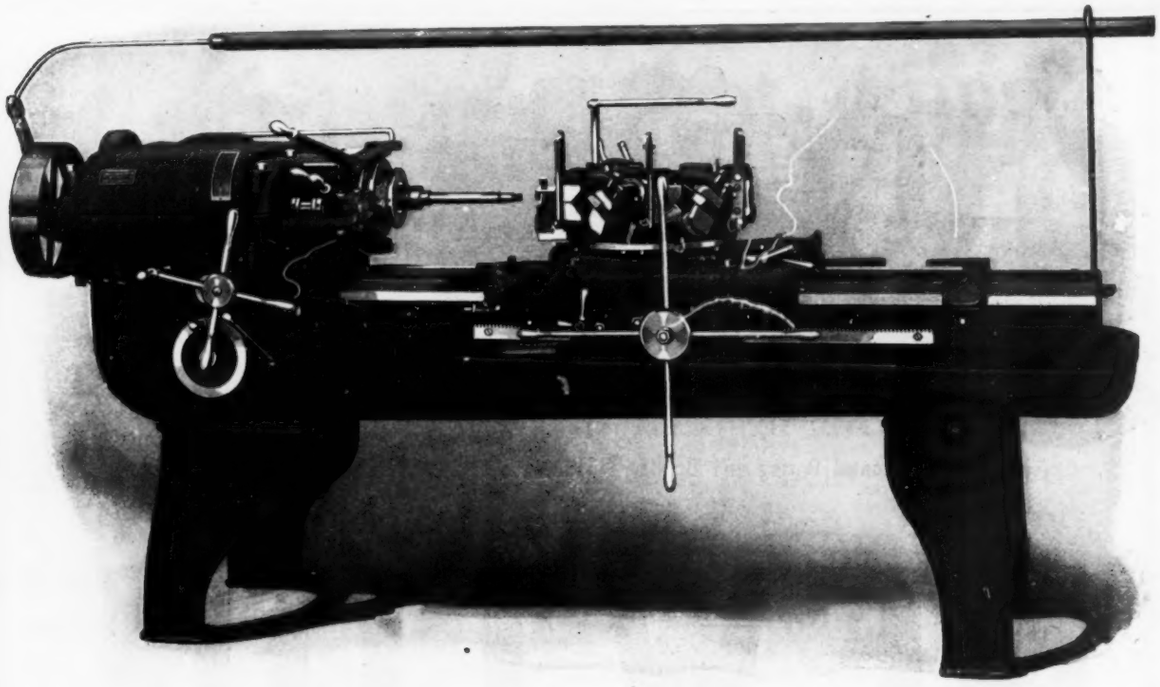
Machines shown above are our Standard designs. Spindles are 5″ dia., 60″ traverse, have 6 changes of geared feed and are driven by worm and worm wheel of steep lead through back gears either by motor or 4-step cone. Knee is made 6′ or 9′ long.

Cold Saw Cutting-off Machines
Rotary Planing Machines

Heavy Portable Machine Tools

Milling Machines
Slotting Machines

NEWTON MACHINE TOOL WORKS, Inc.,
PHILADELPHIA, U. . A.



Flat Turret Lathe Facts Condensed

It has a Flat Turret.

It has cross-feed head.

The turret slide has double stops for each position of the turret.

All speeds and feeds are instantly obtainable.

The turret turns automatically to the position required, skipping other positions.

The tools do not overhang.

It takes a cut on long work from, instead of toward, the chuck.

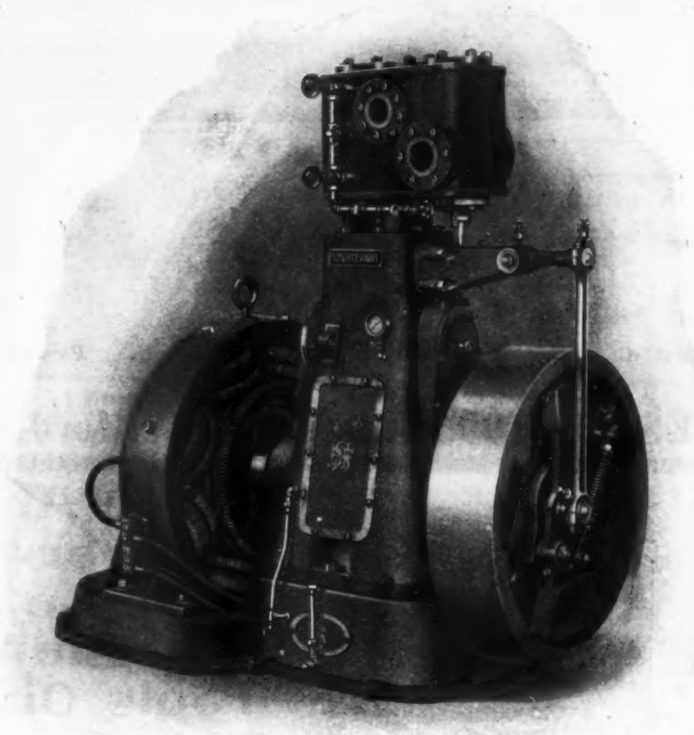
Has universal outfit of tools for either bar or chuck work.

Jones & Lamson Machine Company,

Springfield, Vt., U. S. A., and 97 Queen Victoria St., London, E. C.

Germany, Holland, Belgium, Switzerland and Austria-Hungary: M. Koyemann, Charlottenstrasse, 112, Dusseldorf, Germany.
France and Spain: Ph. Bonvillain, Rue Blanche, 6, Paris, France. Italy: Adler & Eisenschitz, Milan.

STURTEVANT Generating Sets



Require no attention. Forced lubrication under 15 pounds pressure keeps all bearings supplied, and the oil-tight case is the acme of cleanliness. The generator is good for 25 per cent. overload for two hours' time without sparking or undue heating.

Send for Bulletin 63.

B. F. STURTEVANT CO.,

Boston, Mass.

General Office and Works, Hyde Park, Mass.

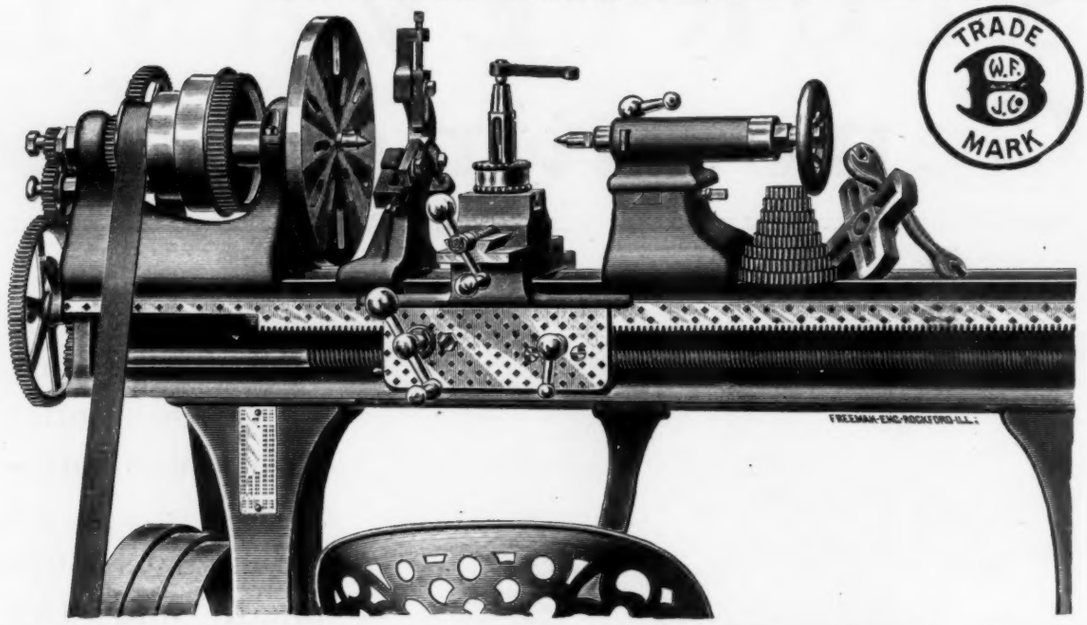
New York Philadelphia Chicago London.

Designers and Builders of Heating and Ventilating, Drying and Mechanical Draft Apparatus; Fans, Blowers and Exhausters; Steam Engines, Electric Motors and Generating Sets; Fuel Economizers; Forges, Exhaust Heads, Steam Traps, Etc.

489

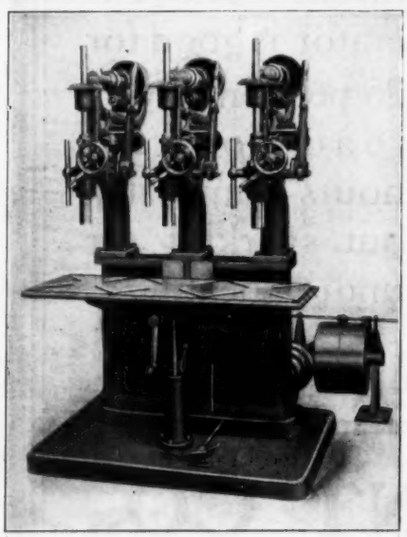
FOOT POWER LATHES

9-INCH TO 13-INCH SWING **The "Original Barnes"**



Screw Cutting. Hollow Spindle. Set-over Tail Stock. Strong. Practical. Easy Running. Send For Catalogue.

W. F. & JOHN BARNES CO., 1995 Ruby St., Rockford, Ill.



Three holes to one.

An increase in results of three to one over old methods and a corresponding reduction in cost come from using

Hoefer 21" Gang Drills

These drills are worth the most careful consideration of manufacturers who seek profit producing results.

Get details of drills and our Power Metal Saw—another money saver.

Hoefer Mfg. Co. Chicago, Jackson St. Freeport, Ill.

AGENTS—C. W. Burton, Griffiths & Co., London, Eng. Schuchardt & Schutte, Berlin, Vienna, Stockholm, St. Petersburg. Alfred H. Schutte, Cologne, Brussels, Liege, Paris, Milan, Bilbao. J. Lamberrier & Co., Geneva, Switzerland

We make fuel gas plants too.

Forge And Temper Your Lathe And Planer Tools On This Gas Forge No. 2,

also Short Drills, Taps and Reamers or similar work.

This gas forge gives a uniformity of temperature which can be controlled to any required degree—the best conditions for the best results.

The entrance is 6" wide by 3" high, with a depth of 6", and it heats bars up to 2" square by 6" long.

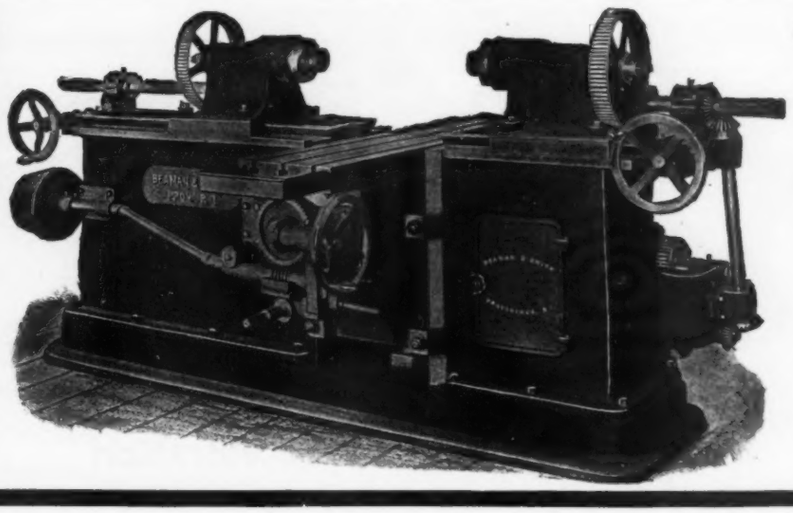
For description get "High Speed Steel Supplement No. 2."

American Gas Furnace Co.
23 John St., New York.

Machinists' Supply Co., 16-18 So. Canal St., Chicago. W. R. Colcord Machinery Co., 821-823 No. Second St., St. Louis.

Chas. Churchill & Co., London, Birmingham, Manchester and Glasgow. Schuchardt & Schutte, Berlin, Vienna, Stockholm, St. Petersburg. Alfred H. Schutte, Cologne, Brussels Milan, Bilbao. H. Glaenzer & Parraud, Paris.

B&SCo



B&SCo

In some cases you can cut milling cost in half with this No. 2 Duplex Milling Machine

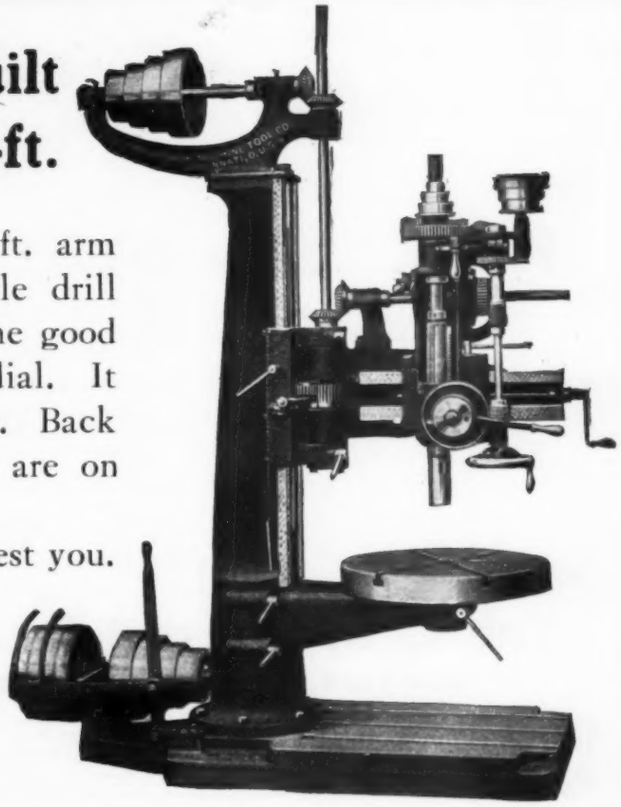
REPRESENTATIVES IN
ENGLAND, Chas. Churchill & Co., London.
FRANCE, Fenwick, Freres & Co., Paris.
GERMANY, Ludw. Loewe & Co., Berlin.

THE BEAMAN & SMITH CO., Providence, R. I., U.S.A.

Fosdick Radials Are Built in Sizes From 2-ft. to 8-ft.

We are showing here the 2-ft. arm style, the most powerful little drill on the market. It combines the good features of an upright and a radial. It has eight speeds and three feeds. Back gears and tapping attachment are on the head.

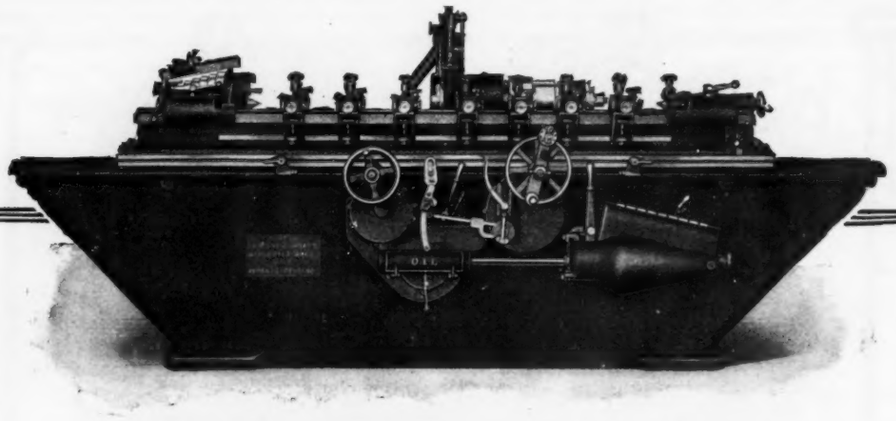
Get particulars; they will interest you.



The Fosdick Machine Tool Company,

Cincinnati, Ohio, U.S.A.

R. S. Stokvis & Zonen, Rotterdam, Holland, Sole Agents for Holland and its colonies.



The Way We Reduce Vibration

in the Norton Grinding Machine is by constructing the bed or frame in such a manner that the work and the grinding wheel are rigidly supported. Where the Norton differs mostly from others is in the

Fixed Wheel Base and Moving Work Table

Convenience, rapidity and accuracy result from it. None surpass the Norton in these respects. It is constructed with great care in every detail.

Simple and rigid cross feed mechanism, all adjustments within easy reach, wide range of speeds, plenty of water. Grinds accurate to quarter thousandths and accuracy is retained for years. Less horse power is needed to operate it than any other grinding machine. Send for catalog and particulars.

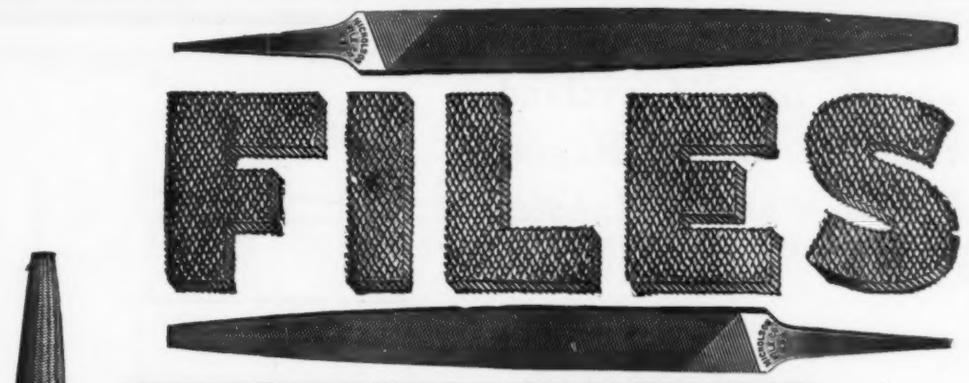
Norton Grinding Company
Worcester, Mass., U.S.A.
Ludw. Loewe & Co., Ltd , London, Berlin, European Agents.

Hack Saws--Starrett Quality.

STARRETT TOOLS are devices for doing things in the mechanical line with the maximum of satisfaction and taking the minimum time about it. Starrett Hack Saws are that kind. They are made to cut a little quicker and last a little longer than other hack saws. You needn't take our word for it. We mean to be truthful, but we realize that we are prejudiced. Send for sample saws and test them yourself. Free Catalogue No. 17-C tells about them and several hundred other good tools.

The L. S. Starrett Co., Athol, Mass., U.S.A.
New York, 123 Liberty St. Chicago, 15 South Canal St.

FOREIGN AGENTS—Chas. Churchill & Co., Ltd., London, Birmingham, Manchester, Glasgow. Schuchardt & Schutte, Berlin, Stockholm, Vienna, St. Petersburg. Alfred H. Schutte, Cologne, Brussels, Liege, Paris, Milan, Bilbao. Adler & Eisenschitz, Milan. W. Hummel fils, La Chaux de Fonds. Wilh. Sonnesson & Co., Malmo, Copenhagen. Acktiebolaget B. A. Hjorth & Co., Stockholm. V. Lowener, Copenhagen. Ignacz Szekely, Budapest. Thos. Drysdale & Co., Buenos Ayres. Edge & Edge, Sydney, Melbourne. F. W. Horne, Yokohama.



FILES

Our firm policy of using the finest steel, tempered and cut according to the best methods known in modern practice was the paramount factor in building the

Largest File Business In The World

Our great factories have an output of 120,000 Files and Rasps daily. 3,000 styles and sizes. Sold and used the world over.

Nicholson File Company
Providence, R. I.

RASPS

Proof Positive of Their Merit.

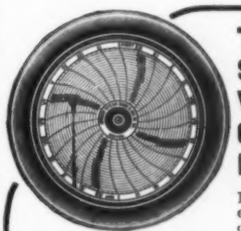
A constantly increasing output for over thirty years of

CARD TAPS

can only come from proven worth to thousands of users.

S. W. CARD MANUFACTURING COMPANY, Mansfield, Mass., U. S. A.

New York Store, 133 Liberty St. Chas. Churchill & Co., London, Birmingham, Manchester and Glasgow.



The Slightest Variation Of Pressure

In a steam boiler or other receptacle is accurately recorded on the chart of the

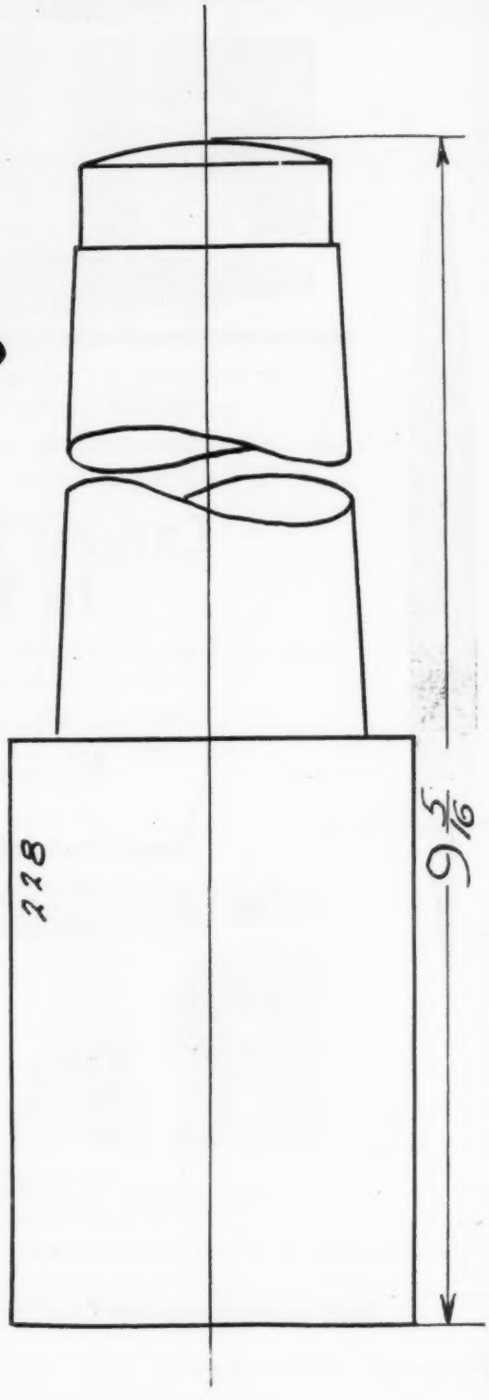
Crosby Pressure Recorder

which works night and day whether you're there or not. You don't have to watch it. Its use has effected many savings in steam boiler plants. Get the Crosby.

Crosby Steam Gage & Valve Co.
Office and Works, Boston, Mass.

92-97 Oliver St., Boston, Mass. 78 John St., New York. 21-23 W. Lake St., Chicago. 147 Queen Victoria St., London.

The Value of the "Cleveland Automatic" Lies in the Rapid, Accurate Way in Which it Handles Duplicate Work.



Piece No. 228—Material, Machine Steel Bar, made on a 2¾" Cleveland Automatic Turret Machine; drawing, full size; output per hour, 2½; this means all operations for completing this piece; actual cost of labor for each piece, from 2½ to 3½ cents. Send along samples or drawings; we guarantee our outputs. One man can operate from 4 to 6 machines.

Cleveland Automatic Machine Co.

Cleveland, Ohio, U.S.A.

EASTERN REPRESENTATIVE—J. B. Anderson, 2450 North 30th St., Philadelphia.
WESTERN REPRESENTATIVE—H. E. Nunn, 199 Lake St., Chicago, Ill.
CANADIAN REPRESENTATIVE—G. H. Howard, Dundas, Ontario.
FOREIGN BRANCHES—Chas. Churchill & Co., London, Manchester, Birmingham, Newcastle-on-Tyne and Glasgow. Messrs. Schuchardt & Schutte, Berlin, St. Petersburg and Stockholm. Alfred H. Schutte, Cologne, Brussels, Liege, Paris, Milano and Bilbao.

The Vandyck Churchill Company

take pleasure in announcing the

OPENING OF A BRANCH OFFICE

—IN THE—

Farmers' Bank Building, Pittsburg, Pa.

where they beg to offer for sale their well-known lines of new

HIGH-CLASS MACHINE TOOLS

No second-hand tools—everything new and of the best quality.

We solicit an opportunity to estimate on your requirements.

VANDYCK CHURCHILL COMPANY

8 Dey Street
NEW YORK

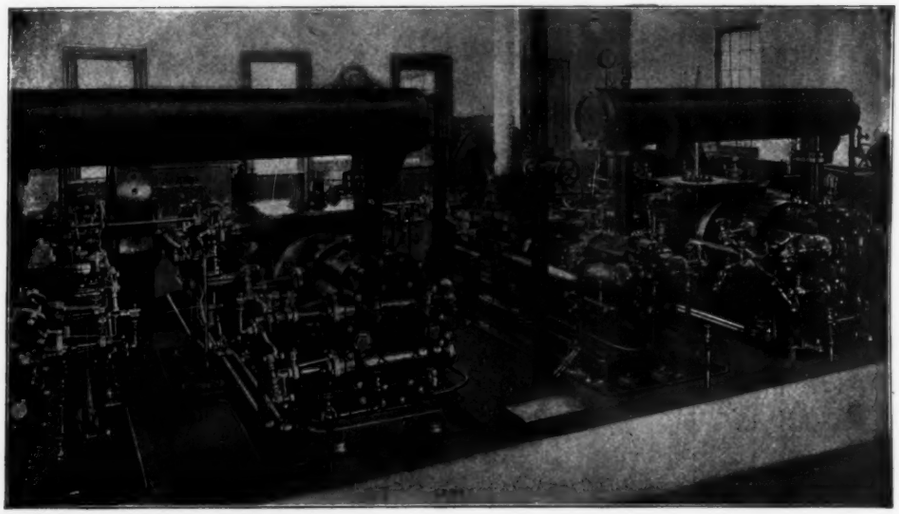
323 Norton Street
NEW HAVEN

The Bourse
PHILADELPHIA

Farmers' Bank Bldg.
PITTSBURG

AIR POWER PLANTS

FOR THE SHIPYARD



Battery of Ingersoll-Rand duplex, Corliss, compound air compressors, in the power house at the United States navy yard, Mare Island, Cal. Capacity 1,600 cubic feet per minute—Speed 100 R. P. M.—Pressure 80 lbs.—Government specifications call for highest refinement of design and efficiency. The United States, in six principal navy yards, uses 21 Ingersoll-Rand compressors of various types and capacities. This fact is a strong recognition of Ingersoll-Rand superiority.

INGERSOLL-RAND CO.

INGERSOLL-SERGEANT DRILL CO. RAND DRILL CO.

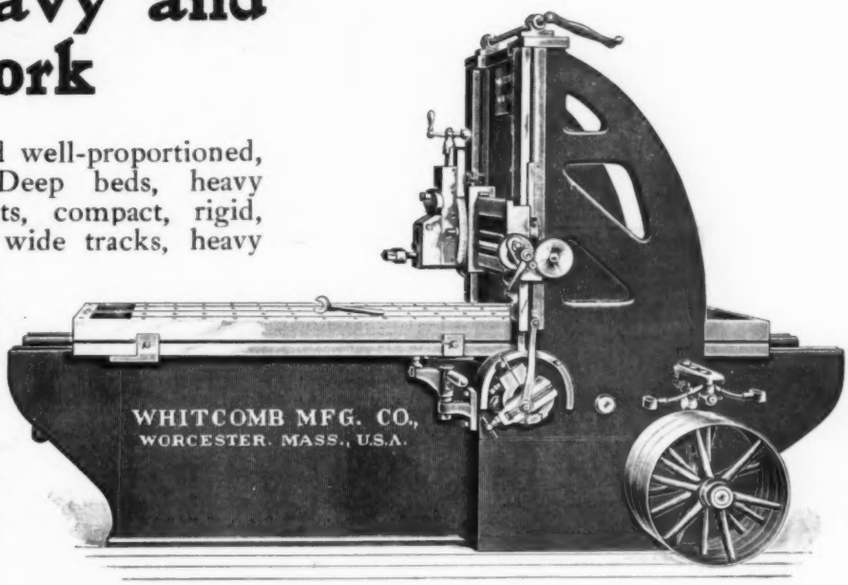
11 BROADWAY
NEW YORK

Cleveland, O. Pittsburg, Pa. Boston, Mass. Philadelphia, Pa. Chicago, Ill. St. Louis, Mo. Houghton, Mich. El Paso, Tex. Mexico City, Mex.

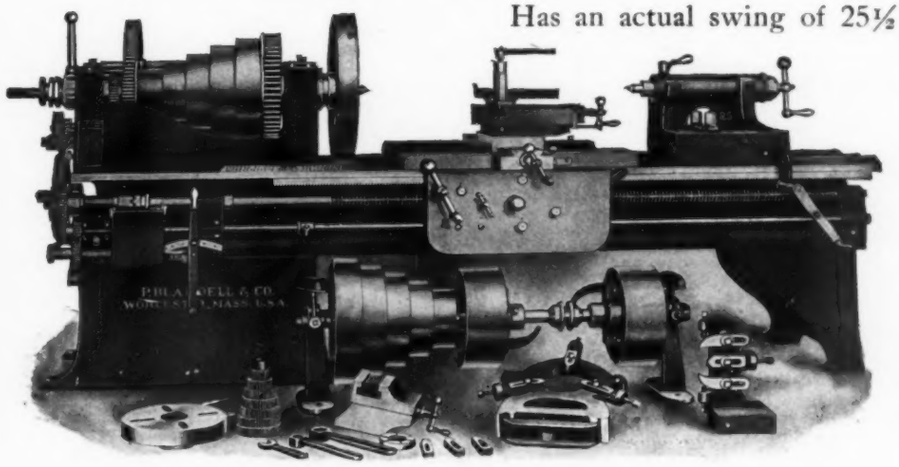
A 43.

Whitcomb Planers Are Adapted to Both Heavy and Light Work

They are heavy and well-proportioned, strongly geared. Deep beds, heavy tables, stiff uprights, compact, rigid, generous bearings, wide tracks, heavy gears, strong headwork, handy feeding mechanism. The Second Belt is the prominent feature—lessens the noise, shock and jar of the usual fast running gears and prolongs the life of the machine.



The 25-inch Blaisdell New Style Compound Rest Lathe



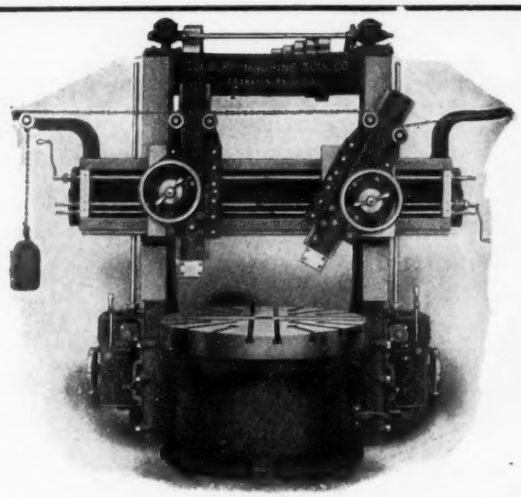
Has an actual swing of 25½ inches over the ways and 18¼ inches over the carriage. New Rapid Change Feed attachment—feeds 8 to 288. Patent Automatic Stop on the feed rod. Steel gearing wherever necessary; steel rack; wide gearing. Back gear ratio, 13.7 to 1.

Full Line of Upright Drills.

Whitcomb-Blaisdell Machine Tool Company

(INCORPORATED 1905.)

134 Gold Street, Worcester, Mass., U.S.A.



53" FRONT VIEW

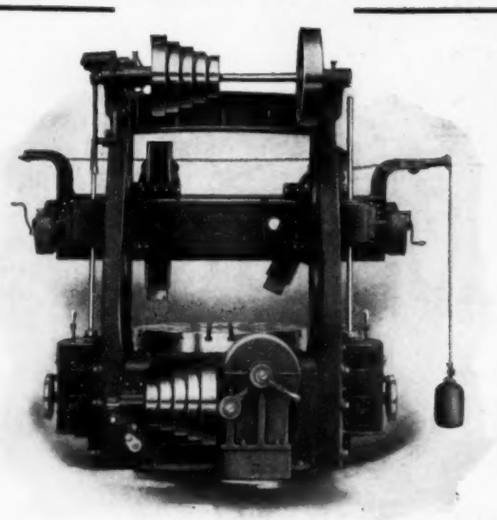
COLBURN BORING MILLS

Are heavy, powerful and well built. Always can be relied upon to do a full day's work at fast cutting feeds and speeds and you can rest assured that your job will be accurate if it comes off of a Colburn Mill. Built by Boring Mill Specialists.

Sizes: 30"—34"—42"—48"—53"—60"—72".

We want you to have our Catalogue. Send for it.

COLBURN MACHINE TOOL CO.,
FRANKLIN, PA.



REAR VIEW

THERE is a Carborundum wheel for every grinding requirement---

Hundreds of shapes and sizes

and grits --- little wheels for jewelers, for diamond cutters, for dentists, great heavy wheels for roll turning and car wheel grinding---hundreds of in-between sizes for every imaginable purpose---and in every instance

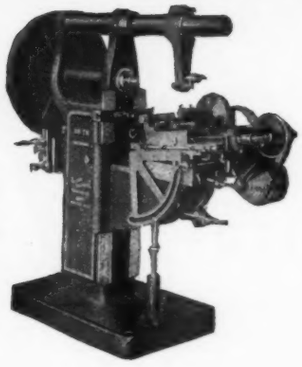
Carborundum

does more work in a day---lasts more days before wearing out---

finishes its work better and requires less attention from the operator than any other abrasive.

Write us about your business and we will be glad to tell you how Carborundum can help you.

THE CARBORUNDUM COMPANY
Niagara Falls, N. Y.



A "MONEY-IN-YOUR-POCKET MACHINE"

THE BECKER-BRAINARD AUTOMATIC GEAR CUTTER

Is in every sense of the word a "money-in-your-pocket machine." Absolutely reliable in every part, latest design, correctly proportioned and of the very best workmanship, it is indeed a practical, money, time and stock saving gear cutter.

Write for Catalog giving dimensions, etc.

BECKER-BRAINARD MILLING MACHINE COMPANY
HYDE PARK, MASS.

THREE POINTS ABOUT THE COES STEEL HANDLE WRENCH

Point One: *Strength.* It is thirty per cent stronger than any other wrench on the market, excepting the new Coes "Hammer Handle" style, just out.

Second Point: *Indestructible.* It is proof against fire, acid, water and abuse.

Point Three: *Economy.* If it can't be destroyed and can't wear out, and it is surely too strong to break, then it is the most economical wrench to buy.

And there's a fourth point—you should get one of the COES styles in your tool box without delay. Send for circulars and choose your wrench. Don't let it be anything "just as good" as a COES.

Coes Wrench Co., Worcester, Mass., U. S. A.

SELLING AGENTS—J. C. McCarthy & Co., 19 Warren St., New York. John H. Graham & Co., 113 Chambers St., New York.

FREE we will grind without charge any sample you may send reporting time and material used

Think of a grinder that's never out of balance, always runs true, grinds steel, cast iron, malleable iron, alloyed metals. wood, gutta percha—in fact, any flat surface with greater accuracy in 50% less time than by any other method—then you are thinking of a

GARDNER GRINDER

because it is the only one of which these things can truthfully be said. Now why not send on your sample, get the facts as to cost, take a look at the work and then order a Gardner?

CHARLES H. BESLY & CO.
15-17-19-21—S. CLINTON ST. CHICAGO ILLINOIS U.S.A.

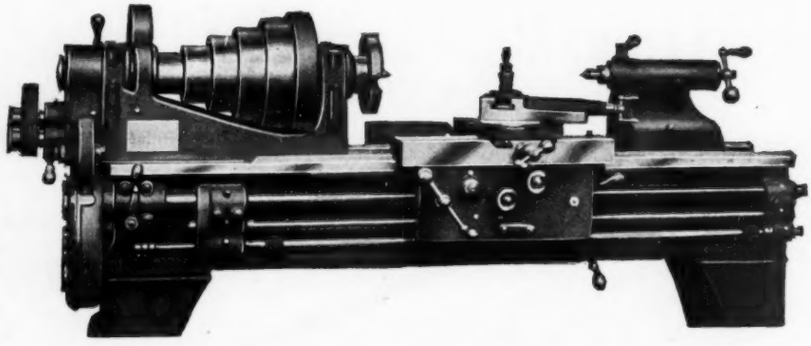
For Both Tool-Room AND Manufacturing Purposes

the Springfield "Ideal" Lathe shown here meets every requirement. It not only covers a wide range, but possesses some very unusual features for rapid and accurate production. Equipped with our patented rapid-change gear device; automatic stop for turning and screw cutting. All changes can be made without stopping the machine.

This particular style is without friction head.

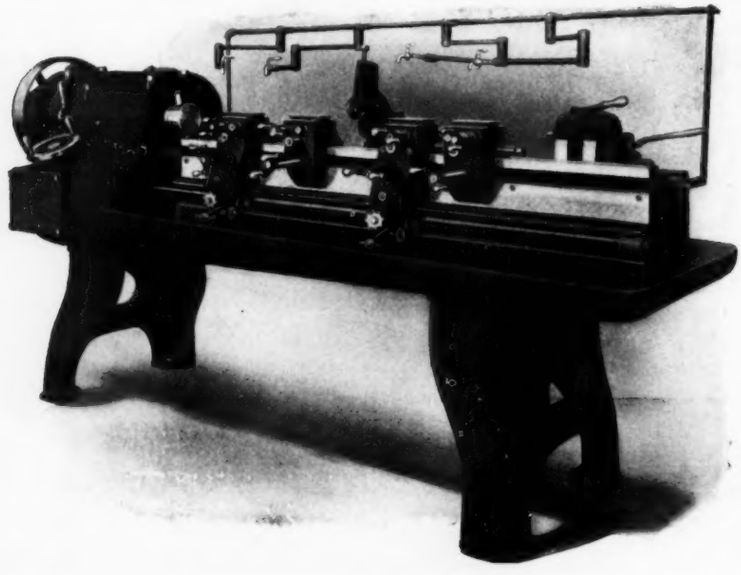
The Springfield Ideal is also built in a style with both friction-head and rapid-change gear left off, and another with friction-head, but without rapid-change gear.

You may have descriptions of them all if you are interested.



The Springfield Machine Tool Company, Springfield, Ohio, U. S. A.

Ing. Vaghi, Accornero & Co., Agents for Italy.



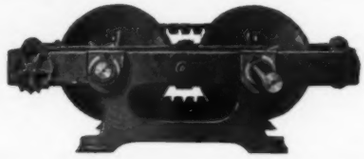
Has the Leading Advantage of the Turret Lathe

In the Lo-Swing Lathe the features necessary for chucking and facing have been eliminated, making it possible to secure many advantages as a single purpose machine, important among them being the use of several tools, each set for one cut only, and brought into action without the delay due to the use of calipers and the making of trial cuts.

Capacity 3½" diameter by 5' long.

Manufactured and sold exclusively by

Fitchburg Machine Works
Fitchburg, Mass., U. S. A.



There's More Profit For You In a Little Faster Speed.

Haven't you often realized that fact when seeing work being put through on a machine at a speed that "eats up profit"?

There are two reasons why work goes through too slow. First, the operator can't always get the speed desired by a step cone pulley arrangement, and secondly, he doesn't always go to the trouble shifting belts if he can get it.

There are just two important things to remember about "The Reeves" Variable Speed Transmission—you can get any speed and get it quickly, with no more trouble than the mere turning of a hand crank.

"The Reeves" is thoroughly dependable and efficient.

Get catalog and note the application to different machines.

REEVES PULLEY CO.

COLUMBUS, IND.

"BLISS"

"Bliss" Inclinable Power Press.

"Bliss" Double-Crank Presses.

There's no excuse for any concern accepting a press inferior to the "Bliss" Press, and a press with a better record for efficiency and durability than the "Bliss" record cannot be found.

E. W. BLISS CO.

Owners of the Stiles & Parker Press Co.

1 ADAMS STREET, BROOKLYN, N. Y., U.S.A.

European Headquarters: Clichy pres Paris, France.
Chicago: Stiles-Morse Co., 65 W. Washington St.

Quick Delivery

Owing to our orders and contracts with the leading Machine Tool Manufacturers, we are now enabled to make prompt delivery, either from stock in our warehouses, or from lots of machine tools in process of construction.

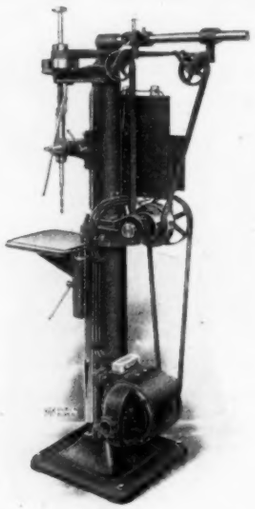
Should you write or telegraph us concerning any machine tools that you wish to secure quickly, we may be able to fill your order at once from stock. We sometimes secure good bargains in slightly used second-hand machine tools, and in way of trade often take slightly out of date machines that are still very serviceable.

We think you will find it profitable to correspond with us when in want of machine tools.

Hill, Clarke & Company,

156 Oliver Street, Boston, Mass.
14 South Canal St., Chicago, Ill.
153 Greenwich St., New York.
504 Fullerton Bldg., St. Louis.

General Electric Company



Electrically Driven Upright Drill.

ACQ Motor Drive

Neat
No detached parts

Compact
Motor well proportioned

Well Insulated
Wiring enclosed in armored conduit

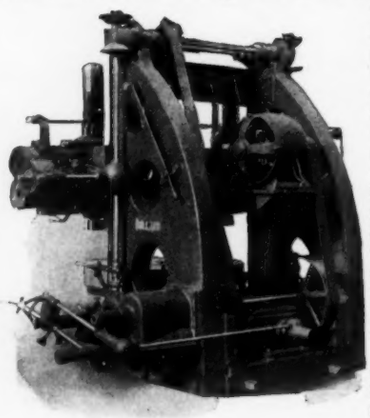
A Model Tool Drive

New York Office, 44 Broad St. | PRINCIPAL OFFICE, SCHENECTADY, N. Y. | Sales Offices in All Large Cities 832

Unexcelled for Individual Drive

Inter-Pole Motors

Maintain constant speed under varying loads



They will carry 100% overload, and can be reversed instantly without sparking. Have a wide speed range. Mounted on ball bearings which enable them to be set in any position. The smallest and lightest motor made for the capacity and speed. Can be used in many places where large, clumsy motors would not go.

Get the bulletin and investigate their merits.

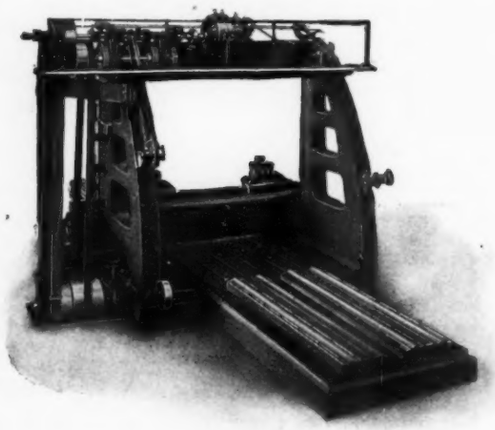
Electro-Dynamic Company,

11 Pine Street, New York

WORKS: BAYONNE, NEW JERSEY.

BRANCH OFFICES:

Cincinnati, O., 1326 Sycamore Street, Philadelphia, Pa., Arcade Building, St. Louis, Mo., 7th and Hickory Streets. Los Angeles, Cal., 116 East Fifth Street. Chicago, Ill., Omaha Building, Boston, Mass., 164 Federal Street. San Francisco, Cal., 105 Main Street. Cleveland, O., Citizens Building. Norfolk, Va., Atlantic and Plume Sts. Pittsburg, Pa., 1201 Westinghouse Building. Detroit, Mich., 75 Bates Street. Birmingham, Ala., Title Guarantee Bldg.



YOU CAN INCREASE

the output of your machines by driving them with our motors. They are unsurpassed for efficiency, durability and reliability. They are non-sparking, compact, and have a strong torque. Write for a copy of Industrial Bulletin No. 21813.

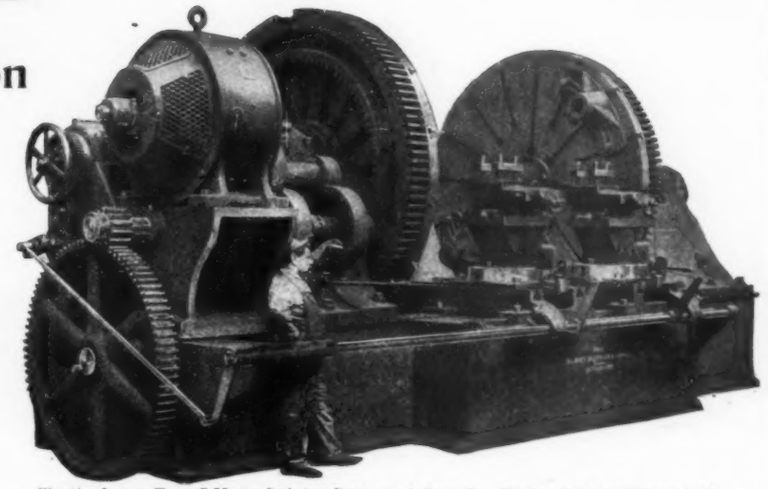
SPRAGUE
ELECTRIC COMPANY

General Offices :: :: 527 West 34th Street, New York

Westinghouse Motors

Increase Production
Decrease Costs

Individual Electric Drive will be found particularly desirable for the larger machine tools, such as machine lathes, frame planers and slotters, boring mills, axle and crank-pin lathes, etc., etc.



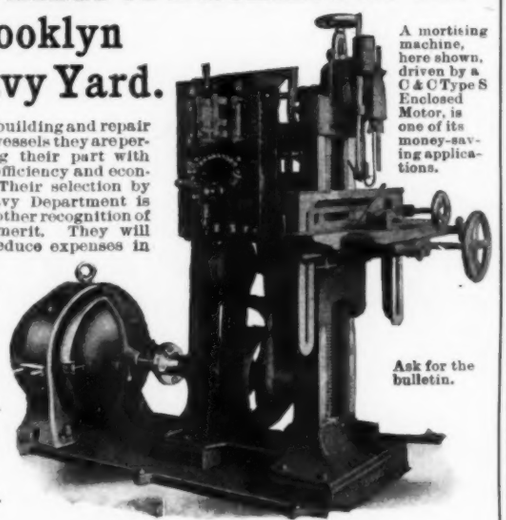
Westinghouse Type S Motor Driving Bertram & Sons Co., Engine-Driving Wheel Lathe.

Westinghouse Electric & Mfg. Co.

Pittsburg, Pa.

Address nearest District Office:
New York, Atlanta, Baltimore, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Dallas, Denver, Detroit, Los Angeles, Minneapolis, New Orleans, Philadelphia, Pittsburg, St. Louis, Salt Lake City, San Francisco, Seattle, Syracuse. Canada: Canadian Westinghouse Co., Ltd., Hamilton, Ontario. Mexico: G. & O. Braniff & Co., City of Mexico.

C & C Motors are driving all kinds of machines at the Brooklyn Navy Yard.



A mortising machine, here shown, driven by a C & C Type S Enclosed Motor, is one of its money-saving applications.

In the building and repair of war vessels they are performing their part with great efficiency and economy. Their selection by the Navy Department is but another recognition of their merit. They will help reduce expenses in your shop. Let us prove it. They are sold with the strongest motor guarantee ever offered.

Ask for the bulletin.

THE ELECTRIC CO. C&C

General Office and Works: Garwood, N. J.

New York Office: 149 Broadway.

BRANCHES—Philadelphia, Boston, Chicago.
ST. LOUIS AGENTS, The Pan Electric S. & A. Co.
PITTSBURG AGENT, H. H. Posse, Park Building.

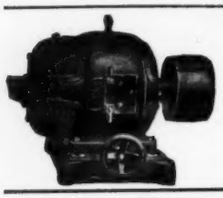
DEPRECIATION

The Machine-Tool Motor

is carefully figured by the modern buyer of electric machinery.

Our machines, built of the best material and plenty of it, are good for years of service without repairs.

CROCKER-WHEELER COMPANY
AMPERE, N. J.



JANTZ & LEIST ELECTRIC CO.

MANUFACTURERS OF HIGH-GRADE

Multipolar Motors and Dynamos.

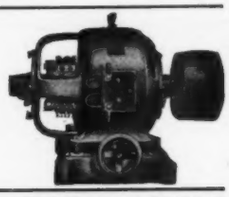
Standard sizes from 3 to 100 K. W., 110, 220 and 500 Volts.

Special Dynamos for Electrotypers and Platers.

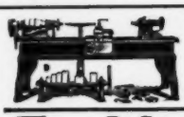
[From 1 to 6 Volts and from 400 to 5,000 Amperes.]

Motors for Direct Connection to all Kinds of Machinery.

N. E. Corner Andrews and Elm Sts., CINCINNATI, OHIO, U.S.A.



Triumph
Electrical Machinery
is adapted to any use.
Triumph Electric Company,
Cincinnati, Ohio, U.S.A. C3



ENGINE LATHES——PATTERN MAKERS' LATHES

13", 15", 16", 18" and 20" swing. 16", 20" and 24" swing.

For details see large advertisement first and third issues each month.

L. ROBBINS, 42 Lagrange Street, Worcester, Mass.

YOU CAN'T GET STUCK WITH THIS RATCHET.

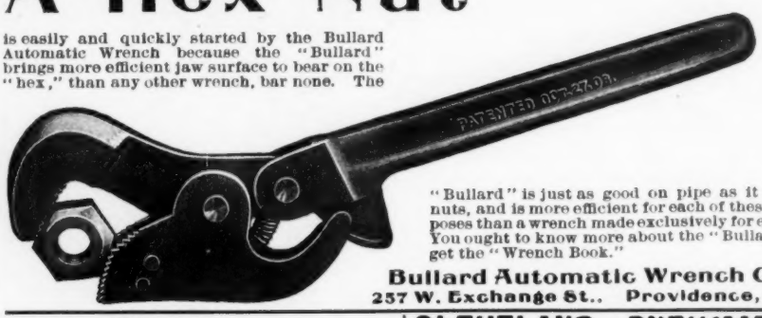
Two inches of motion at end of handle, IN ANY DIRECTION, will drive the Drill.
Patented Nov. 8, 1898, Sept. 26, 1905.
When the other ratchets you have are useless for lack of room to move the handle, get an "ARMSTRONG UNIVERSAL" and it will do the job.

Write For Catalog.

ARMSTRONG BROS. TOOL CO., "The Tool Holder People."
115 N. Francisco Ave., CHICAGO U.S.A.
SEE OUR TOOL HOLDER AD. PAGE 86.

A Hex Nut

is easily and quickly started by the Bullard Automatic Wrench because the "Bullard" brings more efficient jaw surface to bear on the "hex," than any other wrench, bar none. The



"Bullard" is just as good on pipe as it is on nuts, and is more efficient for each of these purposes than a wrench made exclusively for either. You ought to know more about the "Bullard"—get the "Wrench Book."

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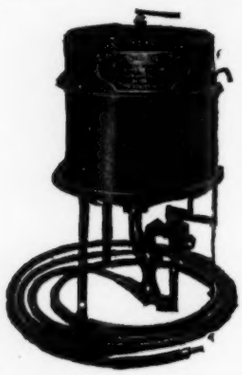

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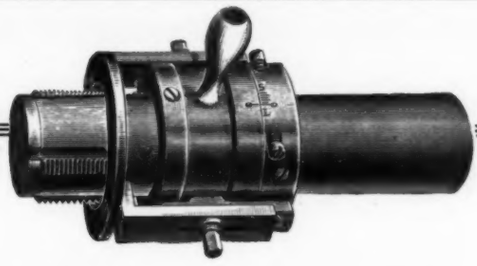

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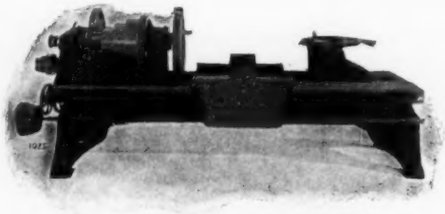
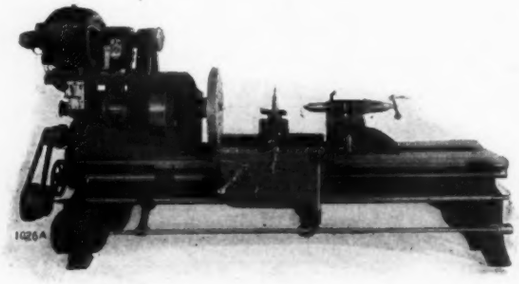


BEFORE MOUNTING MOTOR

Fig. 1. 24-inch Blaisdell Belted Engine Lathe, 8 Spindle Speeds, with standard belted control of spindle speeds.



AFTER MOUNTING MULTI-SPEED MOTOR

Fig. 2. 24-inch Blaisdell Engine Lathe equipped for Variable Speed Drive by Northern Multi-Speed Motor and Saddle shown in Fig. 3. Motor control from apron. Motor speeds 600 to 1370 R. P. M. Total variation, with change gear, 7 to 1.

80 SPINDLE SPEEDS. 3½ R. P. M. to 330 R. P. M.

Fig. 3. Saddle used to convert lathe to motor drive. Top bearing of spindle formed by saddle. Only change required is to remove cap of spindle bearings and set saddle on.

Fig. 4. Northern Multi-Speed Motor pinion drives spindle by chain running on split gear which encircles third cone.

Write for Bulletin 451

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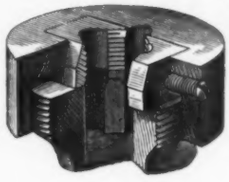
457



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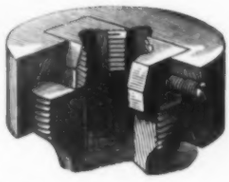

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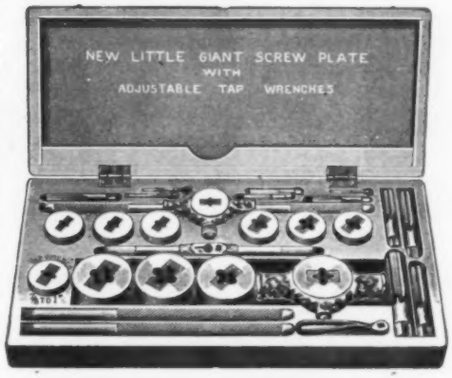

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Other good features in "the book."

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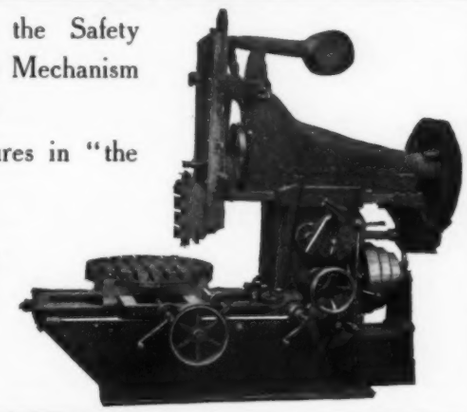

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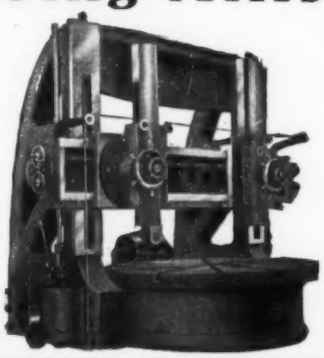

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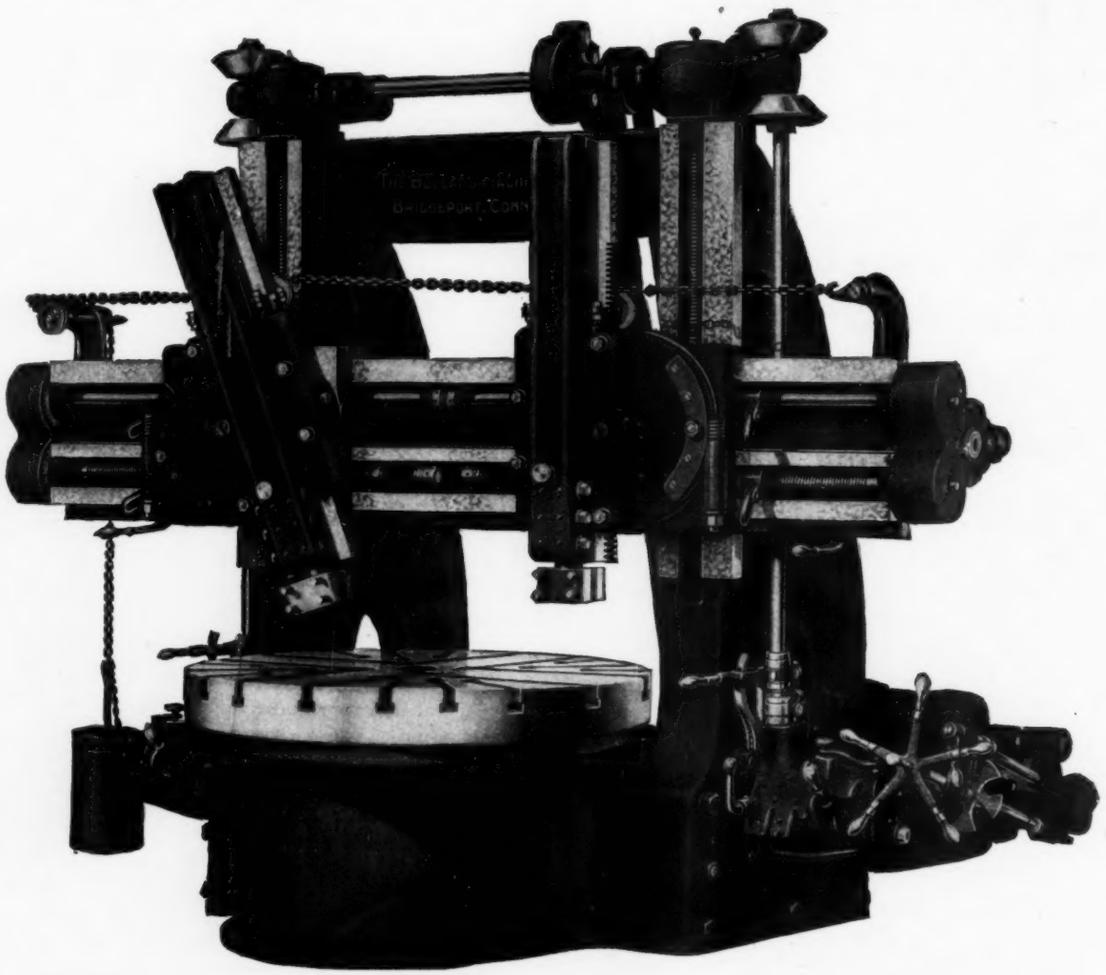

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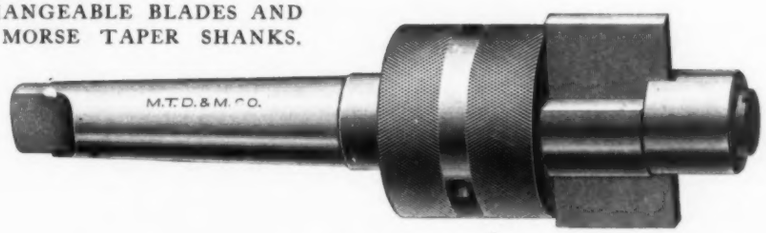

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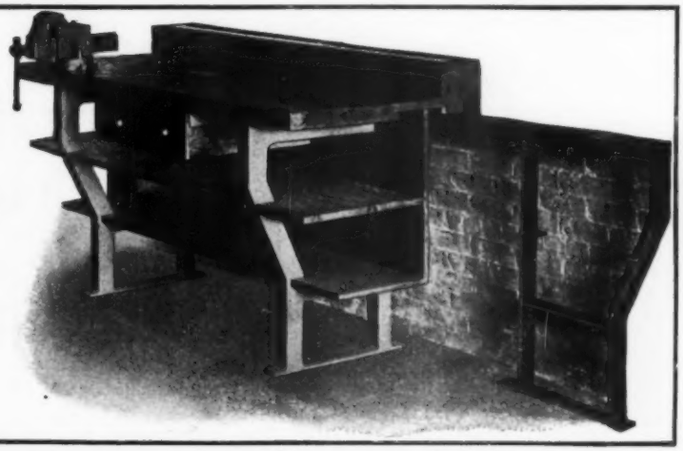

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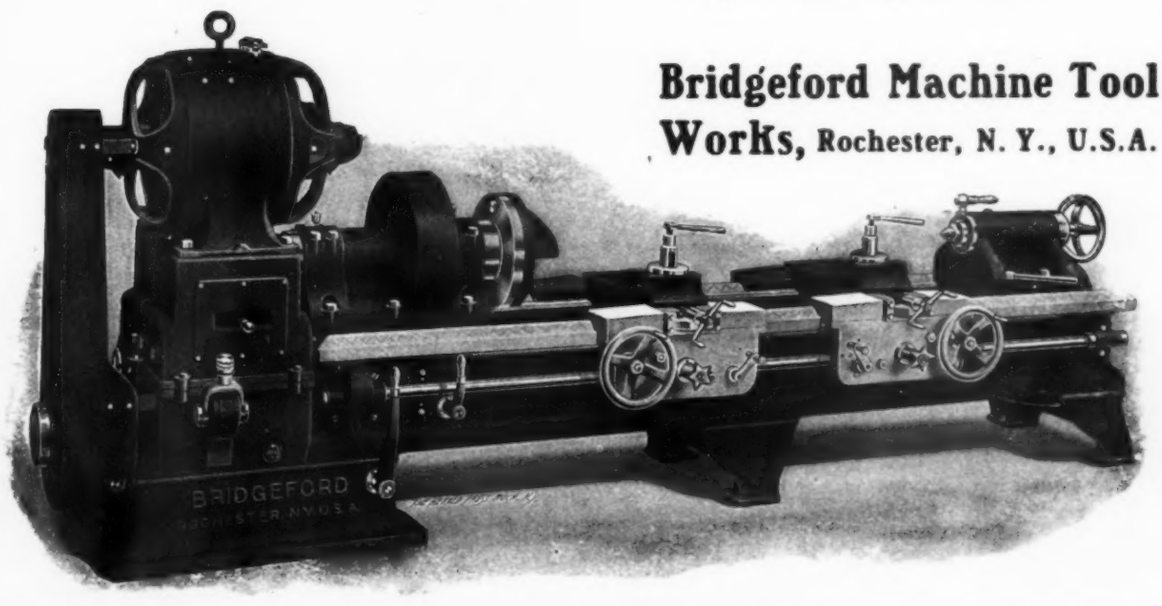

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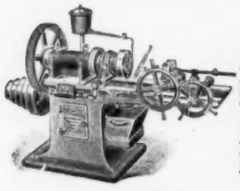

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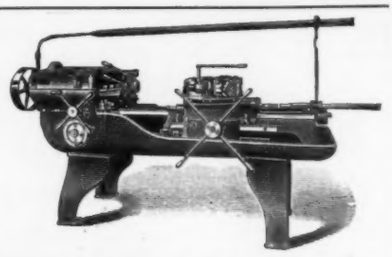

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to get rid of a poor relation than to scrape the humps from a poor job of planing. Gray Planers not only have the power to remove the metal at the highest speed the work and tool steels will stand, but they also have the accuracy and rigidity necessary to produce perfectly true planed surfaces.

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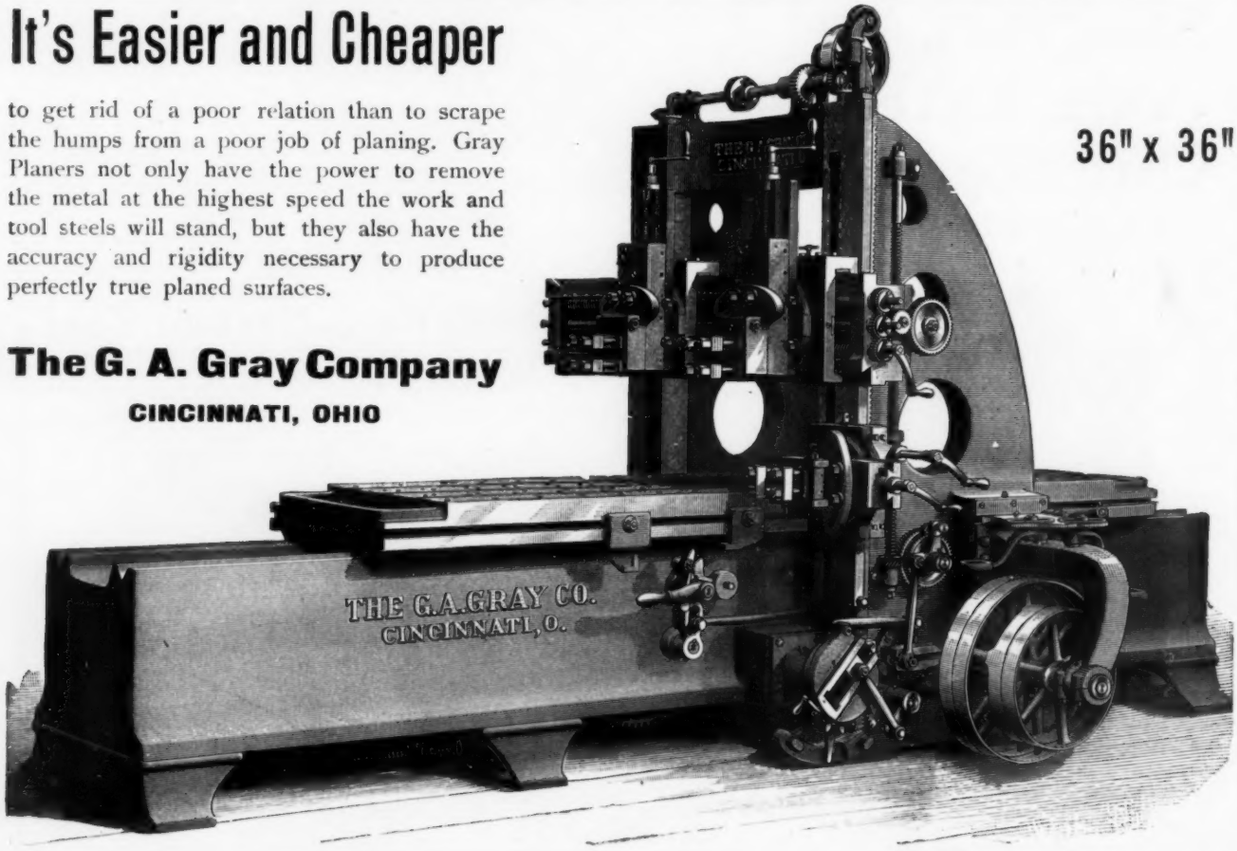


United States Arsenal at Frankford—II.

BY F. A. STANLEY.

As indicated in the preceding article of this series, the inception at the arsenal of metallic ammunition manufacture upon a scale of magnitude dates from 1866-67, when the Ordnance Department decided to adopt for the Springfield converted rifle of caliber .50 a center-fire metallic cartridge. This was something of an innovation at that time, for, although different private establishments had for some years been making metallic ammunition, much of which was, in fact, used in the Civil War, it was principally of the rim-primed class. However, after considerable experimenting, a central-fire cartridge which fulfilled all requirements was developed, and by 1868 its manufacture was being carried on at Frankford upon an extensive scale. This cartridge is shown in the sketch in Fig. 13, and as there indicated, its proportions form a striking contrast to those of the small-caliber military cartridge of the present day, with its slim, smooth bullet and long, slender shell.

AN EARLY METALLIC CARTRIDGE.

The shell, or case, was of copper, drawn up from a 1.7-inch disk punched from "22 wire gage" (.155 inch) stock; and instead of the primer now universally used in center-fire cartridges, a cup anvil was employed, in a depression of which was placed the fulminate or percussion powder. This cup was drawn up from sheet-tin, and two vents were put through from the priming cavity to the open side. After the percussion composition was placed in its depression, the case was pressed down

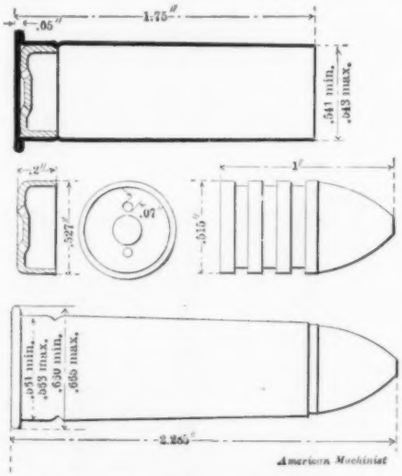


FIG. 13. AN EARLY CENTRAL-FIRE METALLIC CARTRIDGE.

on the cup, bringing the charge of fulminate against the inner surface of the head and in position to be exploded by the impact of the firing pin of the rifle upon the soft copper head. With the case pressed down over the cup, it was tapered slightly throughout its length and indented, as represented, to retain the cup in position. The latter, as will be noticed, not only served as a primer, but also acted as a reinforcement for the case. The bullet was formed with three cannelures for lubricant, and weighed 450 grains, the powder charge being 70 grains. With

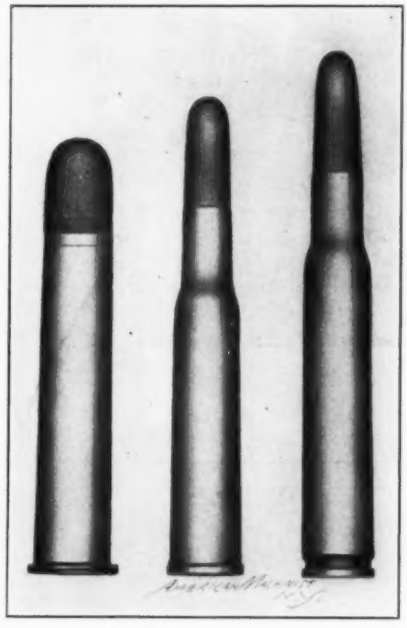


FIG. 14. SHOWING THE OLD SPRINGFIELD, KRAG, AND MODEL 1903 CARTRIDGES. (ABOUT 7/8 SIZE.)

this charge the initial velocity given the ball was about 1,250 feet per second, or just over one-half the speed imparted to the metal-jacketed bullet of the present high-velocity cartridge.

CARTRIDGE EVOLUTION.

In the course of time, the copper-case cartridge was superseded by one having a brass shell, with a primer inserted in the head, and then in 1874 the .45-caliber service ammunition was adopted, and its fabrication commenced at Frankford. A "45-70-500" Government cartridge is shown nearly full size in Fig. 14, it being the shortest one of the group. As the name implies, the powder charge is 70 grains and the weight of the bullet 500 grains.

The central cartridge in the group is the .30 caliber for the Krag-Jorgensen magazine rifle, adopted by our Government in 1892, and just recently superseded in the regular service by the magazine rifle, model of 1903. This cartridge is still made in large quantities at the arsenal, for the use of the militia; but the new rimless cartridge—also shown in the group—and the .38 revolver ammunition are manufactured in still larger numbers.

Both of the .30 caliber cartridges (shown about 7/8 size in Fig. 14) have cupro-nickel jacketed bullets weighing 220 grains, but the rimless case has been lengthened—and strengthened—to receive 44 grains of smokeless power, as against the 37.6 grains of the older cartridge; and the initial velocity of the bullet has thus been increased from 2,000 feet to 2,300 feet per second, and the maximum range with the new rifle extended to 4,781 yards, a gain of 700 yards over the range of the Krag.

AMMUNITION FOR THE NEW RIFLE.

In taking up the work of the arsenal cartridge factory, which now has a total capacity of about 250,000 small-arms cartridges per day, the description will be confined principally to operations on ammunition for the new magazine rifle, the ball cartridge for which has just been referred to. In addition to this cartridge there are made for the rifle a blank cartridge having a paper bullet; a gallery-practice cartridge with a 107-grain lead bullet and a 3-grain powder charge; a guard cartridge loaded with 15 grains of powder and a 156-grain lead bullet; a dummy with tinned, fluted and drilled case, having a bullet like that in the ball cartridge. These are all shown, in the order noted, in Fig. 15. The blank cartridge also has a case that is tinned to distinguish it from the ball case, and is 0.1 inch shorter in total length than the ball ammunition, to prevent a ball cartridge being accidentally assembled in a clip of blanks. The paper

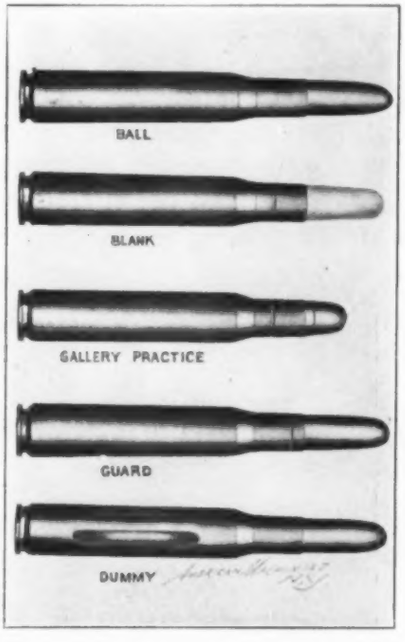


FIG. 15. AMMUNITION FOR THE NEW .30 CAL. RIFLE. (ABOUT 2/3 SIZE.)

bullet contains 5 grains of smokeless powder to insure its bursting in leaving the barrel of the rifle, and is propelled by a 10-grain smokeless-powder charge. The gallery-practice ammunition is for ranges not exceeding 100 feet; and the guard for use up to 150- and 200-yard ranges.

The ball cartridge itself has a total

length of 3.339 inches, and weighs, complete, 450 grains. The case is 2.564 inches long, and the head .473 inch in diameter, the diameter at the neck being .335 inch. The bullet is .307 inch diameter by 1.265 inches long, and enters the case about ½ inch. In the lengths of both bullet and shell there is about 0.010 inch leaway, and the dimensions given are maximum in each case.

OPERATIONS IN CARTRIDGE-CASE MANUFACTURE.

From the sheet brass to the finished case, primed and ready for loading, there are a considerable number of operations, the more important of which are represented in Fig. 16, in proper order. Where necessary in order to show the progression properly, the specimens have been cut back to the center before photographing. As will be noticed, the cup struck up from the disk is elongated by six drawing operations, and between the fourth and fifth draws the bottom end is "bumped" in a heading machine to set the stock in squarely for the final drawing operations. The work is annealed five times during drawing, the sixth or final draw being accomplished without preliminary annealing.

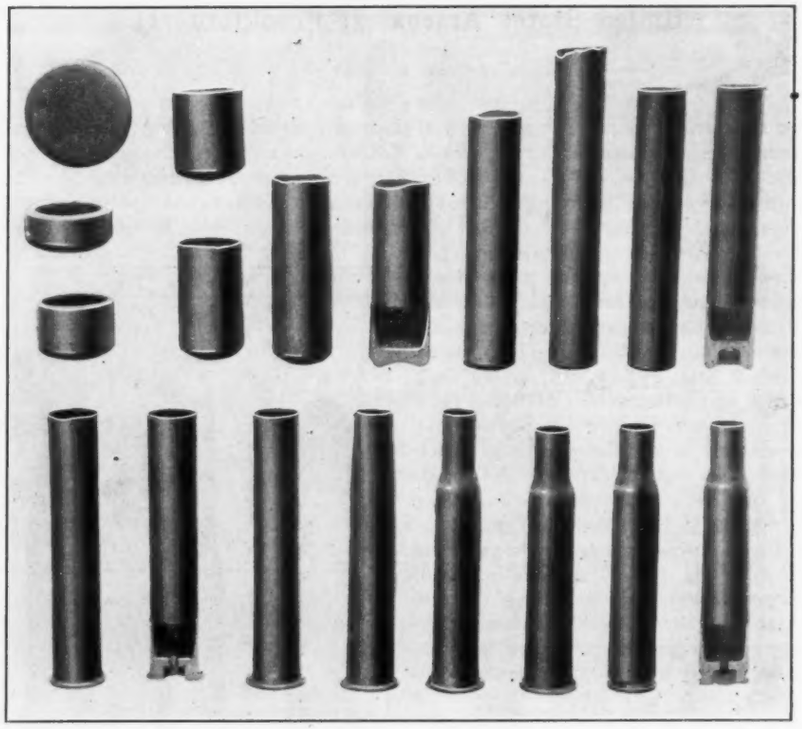


FIG. 16. SHOWING SUCCESSIVE STAGES IN MANUFACTURE OF .30 CAL. CARTRIDGE CASE.

Following the series of drawing operations, the open end is trimmed, leaving the tube a certain length, then the primer pocket is roughly struck in in a machine of the header class. The next operation (illustrated by the first specimen in the lower row) forms a rim or flange, which, though eventually cut entirely away, is necessary in carrying the case through certain ensuing processes; at the same time the initials of the arsenal and the date of manufacture (year and month) are stamped on the head. The primer pocket or chamber is then accurately sized and the vent punched to connect primer and powder chambers, as shown by the flanged shell with base cut away to the center, after which the work is annealed preparatory to being tapered.

The first tapering operation gives the shell an easy taper (about 1-32 inch) from head to mouth to insure its ready extraction from the rifle; the next gives the end an abrupt taper, and the third forms the neck. The neck is now annealed, when another trimming operation is necessary to bring the case to finished length, after which the flange is turned off and the groove formed in a single operation. The insertion of the primer prepares the shell for loading, as indicated by the final specimen in the group, which is cut open to show the primer in its seat. During the progress of the work from cup to com-

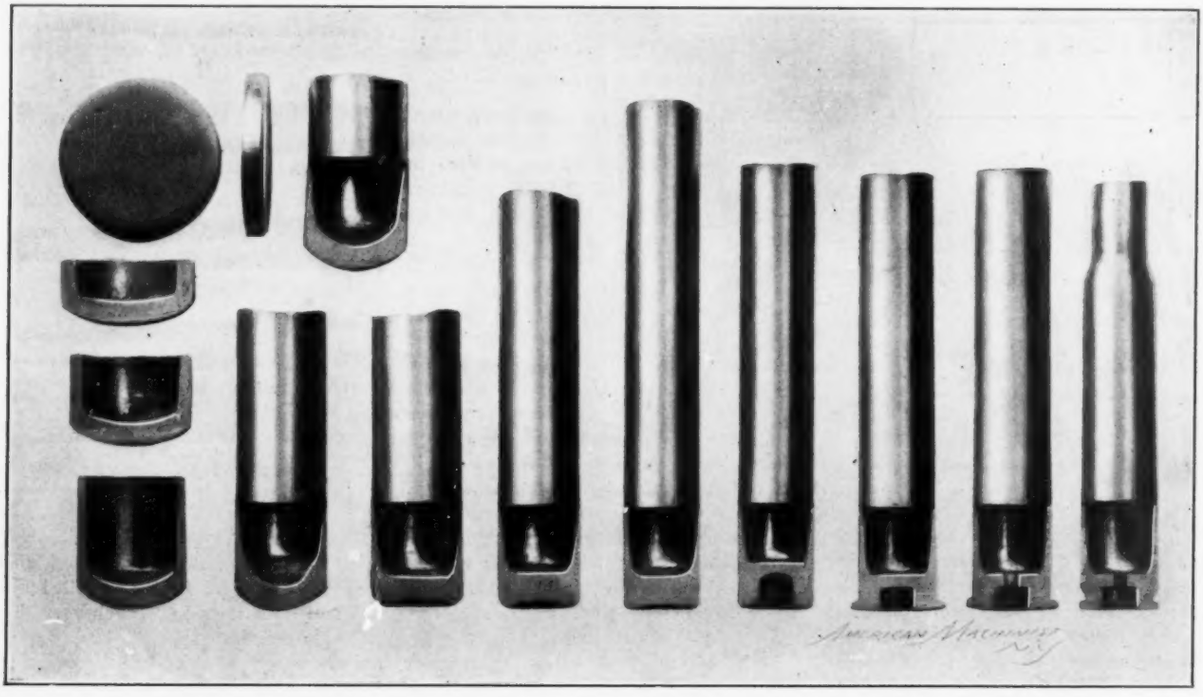


FIG. 17. SHOWING CHANGE IN SHELL SECTION THROUGH DRAWING AND HEADING OPERATIONS.

pleted case there are, of course, numerous gaging and inspecting operations to insure its being held to the required limits.

To illustrate the movement of the metal during the various drawing and head operations, Fig. 17 is presented, the split samples here all being shown nearly full size and bringing out clearly the change in section as the cup is drawn out to the tube and the latter headed, vented, etc. The blank, as punched from the sheet brass, is 0.134 inch thick and practically 1 inch in

FIG. 18. DOUBLE-ACTION DRAW PRESSES. FIRST OPERATION ON CARTRIDGE CASE.

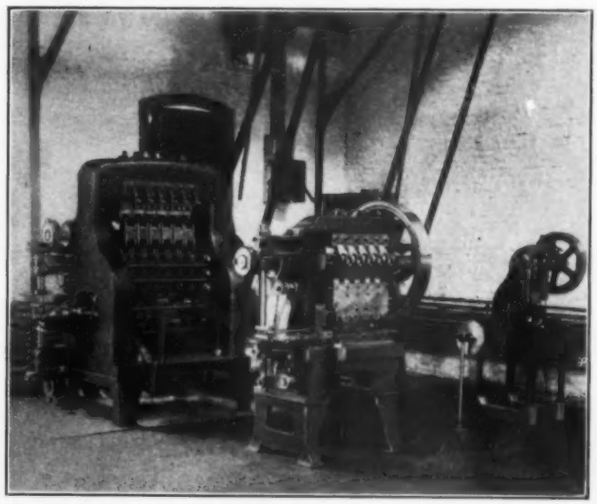


FIG. 19. CARTRIDGE CLIP PRESSES.

FIG. 20. ANNEALING ROOM.

FIG. 21. ANNEALING ROOM.

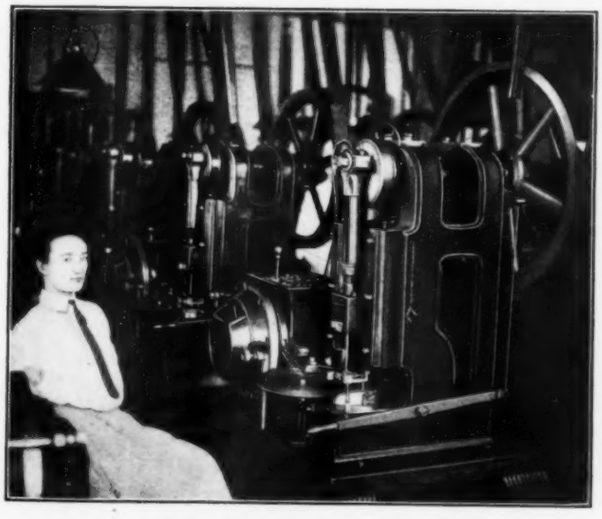


FIG. 22. DRAW PRESSES WITH AUTOMATIC FEED HOPPERS.

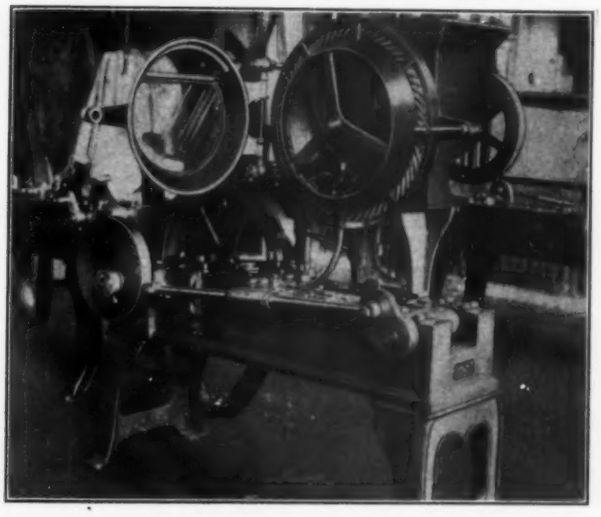


FIG. 23. FIRST OPERATION HEADER WITH AUTOMATIC FEED.

diameter. The walls of the finished case, it will be noticed, are quite thick near the head, while the stock at the mouth or neck is tapered down to about 0.014 inch.

DOUBLE-ACTION PRESS DEPARTMENT.

The sheet stock, as it arrives at the arsenal, is stored in what is known as the metal shed, a one-story brick building, located on the spur track at the end of the cartridge factory. This building contains also the double-action press department and a storage for blank cups, scrap metal, etc. A view in the draw-press department is given in Fig. 18, showing two of the double-action presses (with automatic feed) for blanking and forming the cups from which the cartridge cases are later on drawn up. Two or three presses in this room are kept constantly on the "high-velocity" shell work, each of these blanking out and forming two cups at one stroke. Two other presses blank out and form nickel cups for bullet jackets—three cups at a time in each press—and still other double-acting presses produce cups for the Krag case and for shells for .38 revolver ammunition.

Another view in this room is presented in Fig. 19, and shows two heavy presses for making cartridge clips. The presses, although of entirely different design, handle the same piece of work—the clip body—and form it up complete from the sheet metal, the blank being transferred from die to die by ingenious feeding mechanism. It will be seen that one machine is equipped with six sets of punches and dies, while the other has five only. The work produced here includes also the clip spring, and will be taken up at a later period.

THE ANNEALING ROOM.

The cups, before actual drawing operations commence, are treated in the annealing room, two views in which are shown in Figs. 20 and 21. This department is located at one end of the main cartridge building, and has an extensive equipment of furnaces using crude oil for fuel. The work (whether the original cups or cases in various stages of manufacture) is dumped into a perforated gray-iron cylinder at the furnace mouth, a cover is clamped on and the whole is rolled back along guides into the furnace, where it is slowly rotated by power until the material is thoroughly heated. After cooling off slowly, the work is dumped into a tank of hot water containing a certain percentage of oil of vitriol, then placed in an inclined rotary washtub and thoroughly cleansed with cold water. Trucks, air hoists and trolleys facilitate the handling of material in this and other departments.

Adjacent to the annealing room is a tinning department, where the cases for blank and dummy cartridges are given their distinguishing coats before loading.

DRAW PRESSES AND HEADERS.

On the main floor, next to the annealing department, is located the draw-press section, comprising some fifty machines, quite a number of which are equipped with automatic feeding magazines, enabling one operator to attend to two or more presses. A row of these presses is represented in Fig. 22, and a series of cups will be noticed sliding down an inclined chute on to the rotating feed dial at the front of the press in the foreground. The presses operate at the rate of sixty or seventy strokes per minute, and the life of the dies varies somewhat with the number of the draw; for instance, in the last draw —which is the hardest of the series, as only 0.001 inch variation is allowed in the diameter of the tube—the die will ordinarily answer for about 40,000 shells. The work is well lubricated for each drawing operation, as also for subsequent processes. The diameter of the dies is usually about 1¾ inches, and the thickness 9-16 inch. Considerable bell-mouth is given them, and both punches and dies must necessarily be made of good material and carefully tempered.

In the draw-press department, as in many other branches of the cartridge factory, female operatives are employed to a great extent; and, in fact, they represent nearly one-half of the entire force of 1,200 employed at the arsenal.

In Fig. 23 a header with automatic feed is illustrated; this is a first-operation machine, and sets up the bottom of the work before it goes through the final drawing processes. The feed mechanism is shown more clearly here, and will be seen to consist of a ring carrying a series of inclined, pointed pins and rotating past the mouth of a hopper or receptacle containing the work. As the partially drawn-out shells are agitated by the revolving ring, they slip on to the pointed studs and travel upward and around until, coming into an inverted position, they drop off, one by one, into a coiled tube which leads down to the dies. The die in a heading machine lies in a horizontal position, and as the shell enters it is received and held endwise by a punch fitting the interior of the work, while a heading punch comes up at the rear and performs the required operation.

Most of the headers are located on the second floor, in what is known as the case shop, where the shells are sent after being drawn to length. There are a dozen or more machines for each operation on the head and practically a duplicate plant for heading .38 caliber cases. The dies used in the machines on .30 caliber work are about 2½ inches long by 1½ inches diameter, and as the heads are afterward turned down, a variation of 0.010 inch in the size of the rim as struck up is permissible.

TRIMMING AND TAPERING APPARATUS.

Another type of machine with automatic feed is shown in Fig. 24. This is an end trimmer of a type used more extensively perhaps for bullet-jacket work, of which further mention will be made in another article. In this class of machine the shell as it descends from the hopper is forced into a rapidly rotating spindle, where it is held while a revolving knife, brought up by a cross-slide, cuts it off to exact length, after which work and scrap are slid from the spindle. This end trimming of course precedes the heading of the case.

Fig. 25 is a group of machines for sizing the pockets for primers and punching the vents in the heads. These are obviously hand-fed machines, the shells being slipped in inverted position over the vertical studs. The dial is rotated to carry the work under the punches by ratchet and pawl movement.

Fig. 26 shows a row of annealing machines, through which the shells or cases are passed during the series of tapering operations, thus making the work of the reducing dies easier and also relieving the case finally from stresses caused in making the sharp reduction at the end. Each of these machines has a dial with a series of chucks about its periphery, and as the dial rotates, a shell is slipped into each chuck. The chucks, besides revolving with the dial, have a rotary movement upon their own axes, and thus, while the work is passed through a series of gas jets at the rear, each shell is kept steadily rotating, so that every part is heated evenly.

In Fig. 27, a three-spindle tapering machine is depicted, and the work of each die is quite clear. The temporary rim or head formed on each case is here used to hold it down while the dies are in operation. A row of such machines will be seen in Fig. 28, with a line of head-grooving machines next the wall. The latter machines rotate the work rapidly by means of a spindle, while a forming tool, carried by a cross-slide, turns off the rim, which is no longer needed, and cuts the extractor groove around the head. Like the hand-fed headers and mouth trimmers, the head groovers are provided with material by an inclined chute, down which the operator pushes the shells crosswise against a receiver, which allows them to be chucked one by one, machined and ejected.

PRIMING AND INSPECTING.

The primer department, Fig. 29, occupies a small building by itself at the rear of the factory, and, like every branch of the main establishment, is motor-driven. The numerous double-acting presses blank out and form the cup at the rate of 300 each per minute; and the anvils for the primers are produced at the same rapid rate. The primer cup is of gilding metal (very light copper), and the anvil of

brass; the composition is non-fulminate, being composed of sulphur, sulphide of antimony, chlorate of potash and glass. The cups are prepared for charging by shaking them into shallow pockets formed in a rectangular plate. There are several hundred holes in this plate, and when the latter is quickly moved to and fro in a mass of the cups, the latter fall into the pockets, usually open end up, owing to the fact that the closed end is heavier and slightly rounded. Such as go in wrong end up are turned over, and the plate is then placed under the charging plate, which is of thin steel with small holes drilled through and countersunk from one side, these holes corresponding in number and arrangement to those in the cup plate. The conical recesses in the charging plate are of the right size for a charge of priming composition, and this mixture is spread across the plate and then brushed off, leaving each countersunk pocket filled flush with the plate surface. When this plate is inverted over the plate of primer cups the charge is instantly transferred to the cups, and the cup plate is then placed, with a strip of shellacked paper, under a press having a series of punches, which quickly push a shellacked disk down into each cup to protect the composition.

The anvils are cup-shaped, and in punching them out two vents are cut out at opposite sides. To receive the anvils the primed cups are again shaken into a plate, and the anvils placed on a corresponding plate and then transferred to the cups by inverting the anvil plate over the other and placing the two under a hand lever press, when the two hundred and odd anvils in the plate are firmly seated in as many cups by one stroke of the press.

The primers are inserted in the cartridge cases (preparing these for loading) by means of the machinery in Fig. 30. Each machine has two operators—one to supply the machine with primers and the other to examine the shells and place them on the feed dial. The primers are carried open end up by a dial under the notched disk which carries the shells forward, and at each stroke of the punch underneath a primer is forced up and seated in a shell. If by accident a shell gets past the seating punch without receiving a primer, a small punch passing up through the exposed vent in the head causes an electric bell to ring, and the unprimed case is then caught and returned to the feed dial.

Fig. 31 shows a group of shell inspectors, who examine every case for flaws and defects of one kind or another. Each inspector has an individual bench or table, and in this department, as in the others, all conveniences are provided for handling the work with facility.

As indicated by various views presented, the different departments in the factory

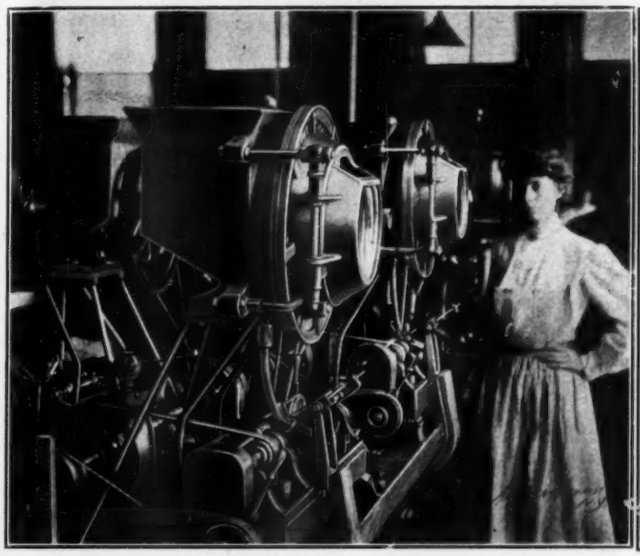


FIG. 24. END TRIMMERS WITH AUTOMATIC FEED.

FIG. 25. POCKET SIZING AND VENTING MACHINES.

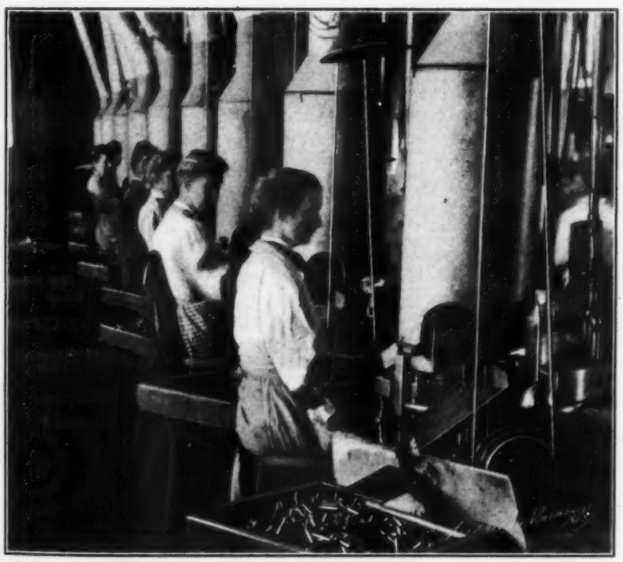


FIG. 26. ANNEALING MACHINES.

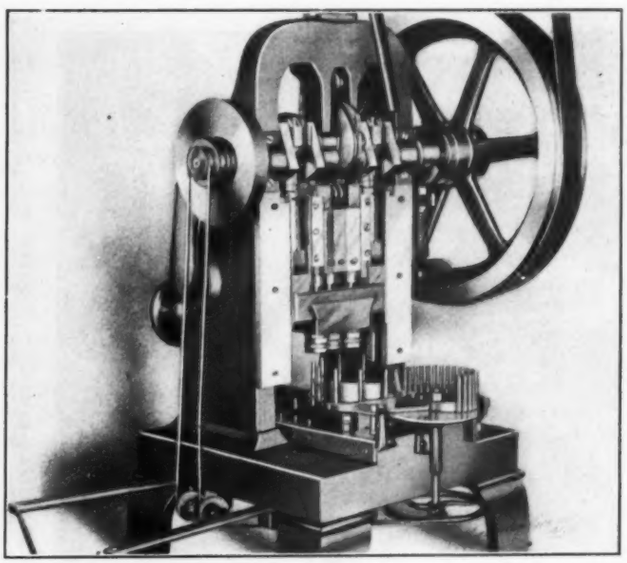


FIG. 27. 3-SPINDLE TAPERING MACHINE.

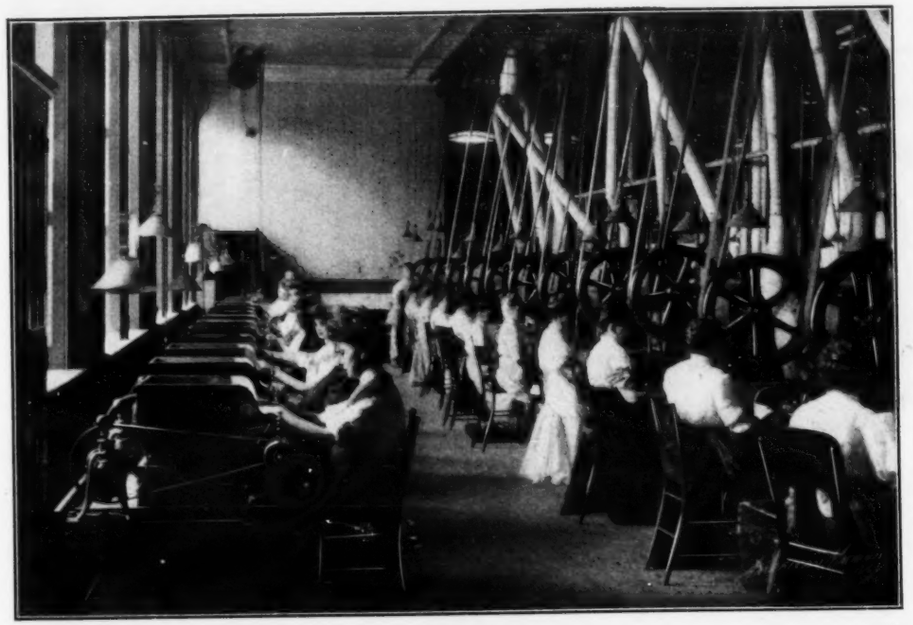


FIG. 28. TAPERING MACHINES AND HEAD TURNERS.

FIG. 29. PRIMER DEPARTMENT.

FIG. 30. PRIMER INSERTING MACHINES.

FIG. 31. CARTRIDGE CASE INSPECTORS.

are all well lighted, and the machinery well arranged and looked after. There are tool-rooms on both floors to keep up punches, dies, etc.; and the general arrangement of the plant is such that the work advances steadily from the drawpress department to the loading shop, and thence to the packing room and the storehouse. Practically all of the machinery, whether for case work or for bullet-jacket manufacture (which will be taken up in the next article) is driven by ceiling motors, which are connected by silent chains to the various lines of shafting.

Echoes From the Oil Country—An Old Motion in a New Dress.

One mechanic was showing another one a large gas engine which he was just setting up at the place where it was to be used. It was rated at 500 horse-power, and was of massive construction, being designed for hard work where it would not do to have anything fail in an emergency.

After looking over the general outlines, the visiting mechanic remarked: "Is there anything particularly new or out of the ordinary about it? I have noticed that all of their work is made very heavy, so that is not new in this."

"Almost everything is following what they have been doing before, but there is one motion here that may be new to you. I know it is to me," replied the other, as he led the way around to the other side of the engine. "Did you ever see a motion like that?" he asked, as he pointed to the way the motion was transmitted to the shaft that moved the valves and the electric igniters. "It struck me as very odd at first, and it looks funny going, as it seems to have a kind of lop-sided motion, but it works very nicely. There is not the least bit of a knock to it, and it has not even warmed up, so I guess it is all right. How does it strike you?"

The visitor looked it over, and then said, with a laugh, "I have heard fellows claim that they had got up a crank without a dead center, and I guess here it is, but I never thought of doing it that way. If it is strong enough to stand the work, I cannot see why it isn't all right."

The engine was a four-cycle one, and to get the valve motion a shaft was run back alongside of the bed and cylinders at right angle with the crankshaft. This shaft had to make one revolution for two of the crank.

The crankshaft on an engine of this size is large, and to get this motion with gears would take up considerable room, and necessitate the use of large gears if they were placed inside of the flywheel, as is usual in smaller engines. If they were placed outside of the flywheel it was a troublesome detail to get suitable bearings that would not give trouble.

In this case a piece that amounted to a double-throw crank with pins equal distance from the center was fastened securely to the outside of the flywheel hub. Back of the rim of the flywheel was a short shaft that was carried in bearings which were bolted to the bed. This shaft was parallel to the crankshaft. On the outer end of it was a two-throw crank of the same dimensions as the one that

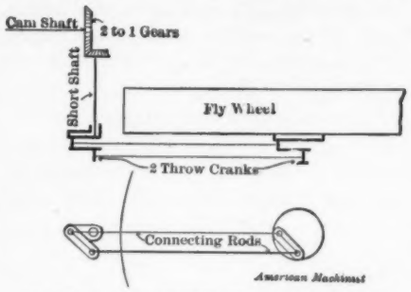


DIAGRAM OF MOTION FOR CAM SHAFT.

was on the flywheel. These two cranks were connected together by two connecting rods, and it is plainly to be seen that when the crankshaft revolved the short shaft had to revolve also, and that with the two cranks and the two rods it did not have any dead center, but did have the same motion as the main shaft. A bevel gear on the end of this small shaft and one twice as large on the end of the cam shaft gave that shaft the desired motion. Whatever might be thought of the looks of the combination when running, it was all where it could be readily got at for repair or for any attention it might need, and the visitor was very much interested in it.

The diagram may help give an idea of the arrangement.

The visitor was so much impressed with the arrangement that he mentioned it to several friends when he got home, and they all said it was new to them. Among these friends was one who said that he remembered seeing something that embodied the same idea, although it was worked out somewhat differently, and was only a model that, so far as he knew, had never been put to any practical use. In this model there were two eccentrics set quartering on the main shaft, and the ends of the eccentric rods were attached to a two-throw crank.

Later in the day this friend came walking up with a grin on his face. "Don't it beat all how easy it is to fool a man? All that is needed is to dress some old thing up in a new way and we don't recognize it."

"What is it now?" he was asked.

"Why, it is that valve motion you were telling me about this forenoon, and we thought it was a new thing. We are bright, I must say. What is the matter with it on a locomotive?"

"Do they use it on locomotives?"

"Do they! What else is it on the drive wheels. The side rods are the connecting rods, and the wheels and axles are the two-throw cranks, that's as sure as you live. The only thing about them is that sometimes there are several shafts that get motion from the first one. I ought to be kicked for not seeing it the first thing, for I worked around locomotives for years and did lots of work on those very things."

"Well, I'll be darned. We are as bad as the fellows who got fooled with that new pump. I am afraid that I would have wanted that sort of a motion a long, long time before I should have thought of that way of getting it. I wonder whether this very thing isn't old to men in some other parts of the country. Maybe there are a lot of other good common things lying around loose that would work in if we would only give them a little twist."

"I'll bet there are, and we won't see them until some other fellow gives them the twist," and with another grin he walked away. W. OSBORNE.

Give Us Back the Chief Engineer.

Rear Admiral Charles W. Rae, Engineer-in-Chief of the United States Navy, in his recently issued annual report says:

"So few officers of the line are taking up engineering seriously that the situation is becoming alarming. Were the country suddenly plunged into war, the Navy would find itself in no condition to win battles. As necessary as good marksmanship is the ability to carry our guns to the firing line and to keep them there amid the havoc created by modern ordnance, and this will never be done with amateurs in charge of the machinery. That line officers can become good engineers has already been proved, but they must have experience to become so, and that experience must be acquired in subordinate positions.

The "Bennington" disaster may revert to the ultimate good of the country in emphasizing such utterances as this. The discussion of the anomalous position of the engineer in the Navy which it has induced, while perhaps a little hysterical at times, will be a healthy irritant to bring to the surface the disease existing in our organization. The men who died upon the "Bennington" will not have given up their lives in vain, if that disaster shall prove the inadequacy of our engineering department at a time when it can still be reorganized, instead of letting it develop at a time when inefficiency would mean national disaster. Restore the chief engineer. Give him a cabin, not a hammock; offer him a career, not a job; give him responsibilities, not orders; give him a salary, not a stipend; give him social and official recognition, not toleration; and there will be no dearth of material for the building of an enginering staff that will develop the full efficiency of the vessels entrusted to them, and to which it will be an honor to belong.—*Power.*

FIG. 30. PRIMER INSERTING MACHINES.

FIG. 31. CARTRIDGE CASE INSPECTORS.

Automobile Construction—II.

BY F. C. MASON.

In this paper we will take up the engine, which is of the double-opposed variety, as nearly balanced as it is possible for an engine to be, and consequently gives a maximum amount of speed with a minimum amount of vibration, which is most essential in an automobile.

This engine is not an amateur's experiment, but was designed on well-developed lines, and there have been twenty-five or thirty of them built, all of which have given the very best of satisfaction.

The engine will run from 150 to 2,800 or 3,000 revolutions per minute without load, and at 1,500 revolutions will develop about 10 brake horse-power. It also makes an excellent marine engine. We have had one in a 20-foot launch since last May; it has never failed to start with the first turn of the crank, and there has never been a wrench on it since its installation. The boat is 20 feet long and 5 feet beam, and the engine drives it nearly 12 miles an hour.

Fig. 3 is a working plan of the engine, though only one cylinder is shown, owing to lack of space. Fig. 4 is the cylinder drawing for the patternmaker's use. Fig. 5 is a drawing of the commutator (or spark timer) not detailed; a good size for the brass case is 3 inches diameter by 1¼, the other sizes being in proportion. Fig. 6 is a sheet of details; Fig. 7 a diagram for setting the cams for lifting the valves; Fig. 8 the arrangement of the piping referred to in the previous article.

In describing the making of this engine I will not go into the detail of the simple parts, but endeavor to give assistance on the main points only.

MACHINING THE CYLINDER.

In building a gasolene engine perfect work on the cylinder and component parts, viz., piston, rings, piston pin, valve seats and valves, is essential. The cylinder should be bored, reamed and lapped at one setting. As a suitable reamer is not likely to be at hand, a cheap but very efficient one may be made, as follows:

Take a piece of gray iron about 4 inches diameter by 3 or 3½ inches long, and face one end and tap through in the center with a 1-inch tap. Take a piece of cold-rolled steel 1¼ inches diameter, center and thread at one end to fit the gray-iron head, then turn the head down to 3⅝ inches diameter and face the other end. Mill five slots longitudinally in the gray-iron head, ¼ inch wide by 7-16 inch deep, for inserted cutters made of tool steel 11-16 inch wide by 3½ inches long and slightly thicker than ¼ inch, to form a driving fit in the slots in the head. After driving in the blades and turning down to 4 1-64 inches, relieve the backs and make the cutting end like a rose reamer. Number the blades, remove, and harden; drive back in place and then grind to size (4 inches). Grind slightly taper toward the back, say 0.00025 inch, for clearance.

A reamer made in this way will ream as straight a hole as it is possible to ream in a thin shell like the cylinder described. As the reamer will of course generate some heat and distort the thin casing, it will be necessary to resort to the lead lap for finishing, providing a first-class job is desired. The results obtained by this method are well worth the time expended in making the lap.

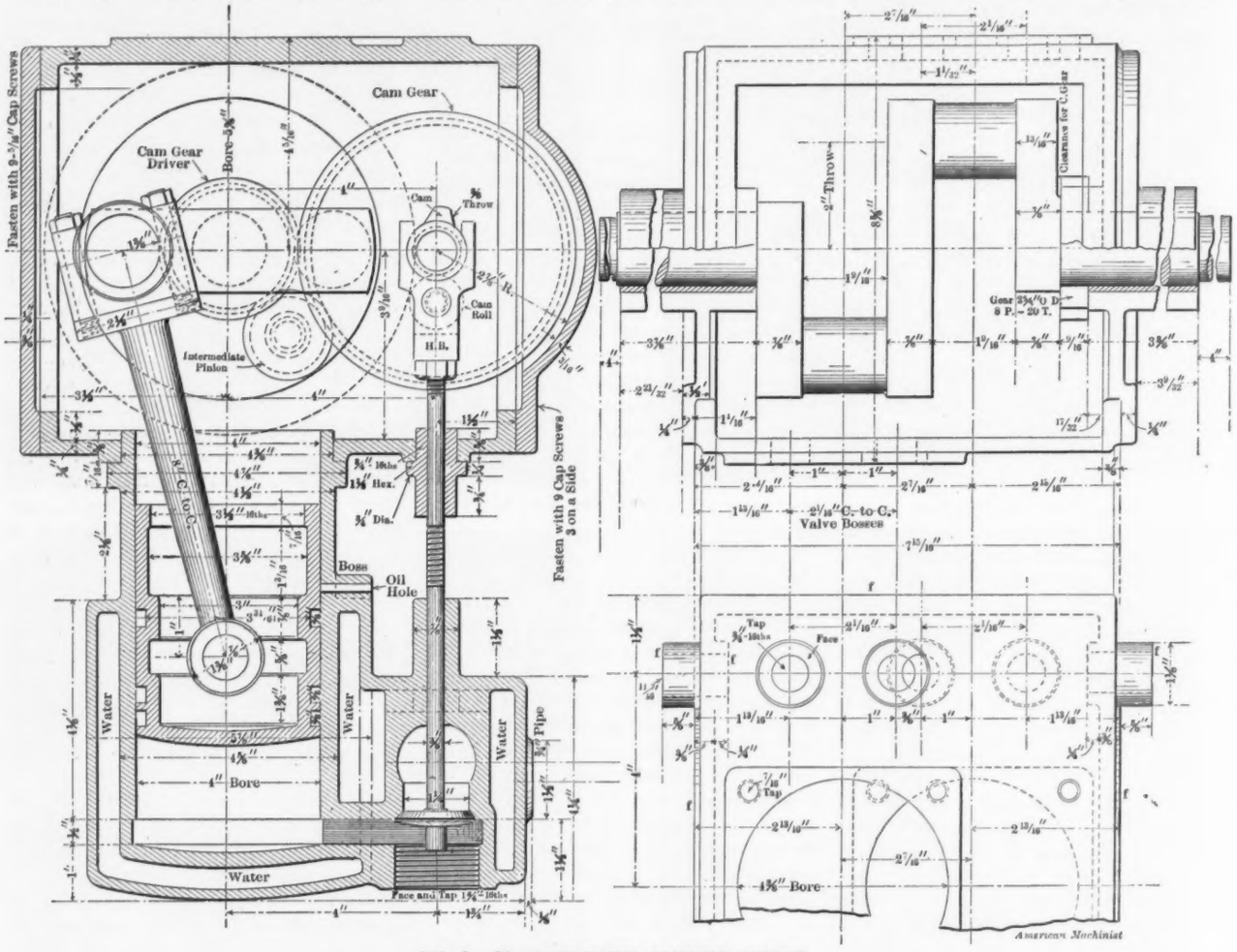


FIG. 3. 10 HORSE-POWER GASOLENE ENGINE.

A CYLINDER LAP.

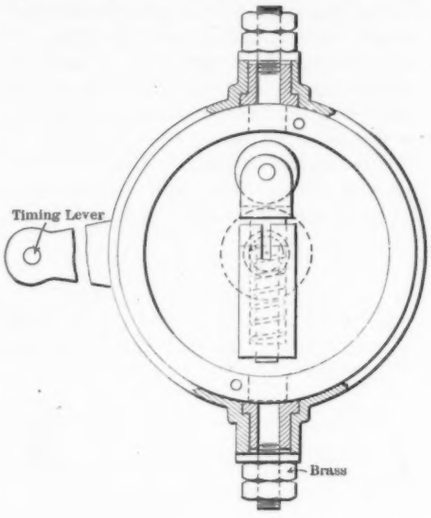
To make the lap cheaply, cast a gray-iron bushing, say 12 inches long by 3½ inches diameter, with a 2- or 2½-inch hole cored in; drill anchor holes around one end for about 4 inches long and cast about ⅜ inch of lead around that end of the bushing. Then put center plugs in each end of the bush and turn the lead

to size. Then remove the center plug from one end, slit open one side of the lap end for a length of about 5 inches, and put in a screw to expand the lap. Use 120 emery and lard oil, and a surface will be produced like a mirror, about 30 minutes being required to each cylinder. If the center end of the lap is put on the tail center and the carriage clamped to the tailstock and the latter left unlocked, the carriage can be used for the lap feed, the feed being either by power or hand. The feed should be rather rapid, to keep the bore straight.

After boring the cylinders the water-jackets must be tested. Plug the holes left by the core prints and test to 60 or 70 pounds pressure. Nearly all manufacturers test before the cylinder is bored, but as you have to test again after boring I consider it only time wasted, as ninety times out of one hundred the leak will show up after boring.

SEATING VALVES.

The next operation is boring for the valve stems and seats, and threading for the caps. As the valves have to be an exact distance apart, also radially correct, it will be found advisable to make a jig plate to put on your face-plate to locate the cylinder by. Take a piece of gray iron about 6x1x8 inches, plane parallel and bore a hole in one end 4⅜ inches diameter to fit the flange end of cylinder. Lay out and locate on the face plate and dowel in place. Hold the cylinder on with two straps, locate one valve and finish, then swing the cylinder in the jig for the other. As your compression depends entirely on how well your valve seats are made, great care should be exercised in boring for the stems and facing the seats. As it is 3 inches or over



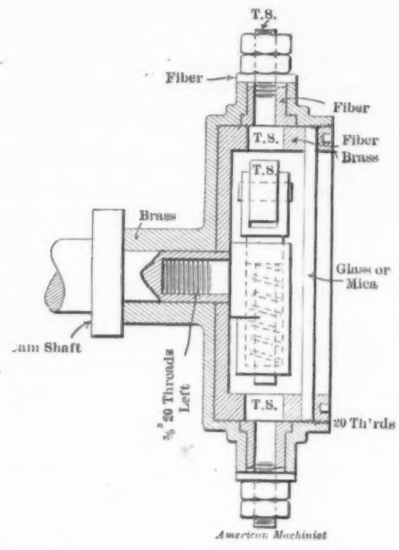


FIG. 5. COMMUTATOR.

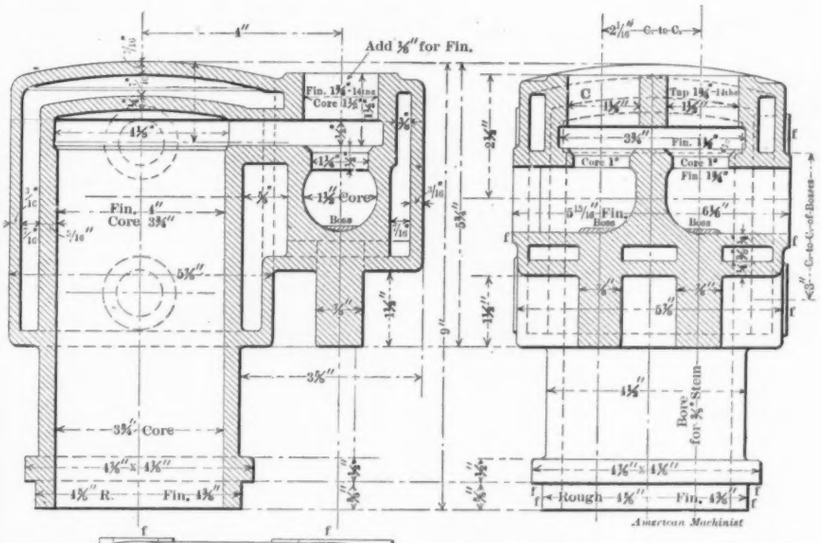
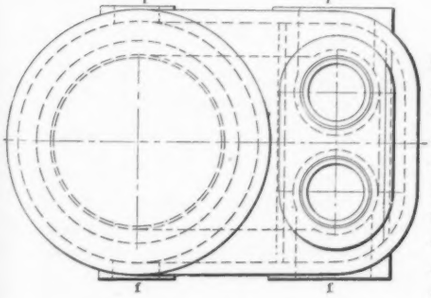


FIG. 4. CYLINDER PATTERN DRAWING.



in to where the drill for the stem is started, and the hole is only ⅜-inch finished, it will be necessary to resort to other methods than drilling and boring with a lathe tool. It is best to drill with a 5-16 drill, then true out the front part of the hole with a lathe tool and bore with a gun drill about .370 diameter, that will leave stock enough for finish with a hand reamer. After the valve seats are finished and the valves made, grind the two together in the usual way.

THE PISTON.

The piston should be fitted as perfectly as possible and still be a free sliding fit that will allow one to pull the piston in and out easily with the hand.

In the detail in Fig. 6, one end of the piston is shown threaded. That is for the purpose of screwing the piston on an adapter while finishing the outside. If the attempt were made to finish it by chucking, the result would be apt to be a distorted piece of work.

The piston should have four or five half-round oil grooves between the threaded end and the first ring; they are not shown in the detail, but may be made about ⅛ inch wide and 1-16 inch deep. The other parts of the engine, as per the detail sketches, do not need any explanation regarding methods of making.

SETTING THE CAMS.

Setting the cams for lifting the valves requires some care, and while the main idea is shown by the diagram, Fig. 7, it still needs some explanation. As the cylinders are opposed, they will explode alternately. In setting the cams, the cylinders need not be on the base. Put the crank base on a surface plate, with the fly-wheel side from you; turn the crank farthest from you around to the right till it comes within 10 degrees of being horizontal; then take the cam farthest from you, which would be an exhaust cam, and bring it up to the cam roll to the point of starting to lift, and lock with a temporary set-screw in the hub of cam. Turn the shaft to the right again a half revolution; then take the next cam, which would be the intake to the same cylinder, and bring it up to the point of lift on the cam roll, and lock. The other two cams for the other cylinder are then set parallel with the first two, and then drilled and fastened permanently with taper pins.

In the detail sheet, the fly-wheel is not shown; it will appear later in connection with the transmission gear. The engine weighs, complete, including fly-wheel, about 210 pounds; by making the crank base and side-heads of aluminum, the weight will be brought down to about 190 pounds, which would be preferable for the auto. In the drawing, Fig. 3, the connecting rod is made of a forging, with

bronze box and bush on the piston end. It is cheaper and just as well to construct the whole rod of bronze; but instead of making the rod proper round, as in the forging shown, have it ribbed I-beam style.

The rails on the belt-line railroad around Philadelphia are the heaviest used anywhere in the world, weighing 142 pounds per yard, or 17 pounds more than any previously fitted. They are ballasted in concrete, with 9-inch girders to bind them. All the curves and spurs have the same heavy rails, which were made specially for the Pennsylvania Railroad by the Pensylvania Steel Company. An officer of the railroad states that this section of the road ought to last for twenty-five years without requiring repairs. The section is considered superior to any other in existence.

It is stated that since the completion of the construction work on the Simplon Tunnel the question of operating trains in it by electricity is being debated. A firm of Swiss engineers is said to have made a definite proposal to electrify the line.

How to Start a Foreign Trade.*

BY F. F. PRENTISS.

Considering the keenness, nerve and energy which the American business man shows in pushing his product at home, it is puzzling that he has not developed a larger and more general foreign trade. If statistics could be gathered, I have no doubt that the number of failures on the part of American business men to establish a foreign trade would be a revelation to the somewhat egotistical American commercial world. What has been the chief cause of these failures? And what is the proper course to pursue and the methods to use in starting a foreign trade?

The American business man will not go to the heavy expense, the long labor and hard struggle necessary to get a real foothold in a foreign country. An analysis of the situation will show that he has some justifiable reasons for this attitude, but the majority are without foundation.

That comparatively new and flourishing branch of business enterprise—advertising—is a product and instrument of the Western world. Advertising has come to be the strongest arm of the American manufacturer's sales organization. He still has his salesmen; he needs his display rooms; he must make personal visits. But advertising, even though it does not close up the deal on a sale, at least prepares the way—it blazes the path for the salesman; it serves as his letter of introduction; it opens the door to him. At one point or another in the sale it reduces the physical effort and mental strain of selling. It is a comparatively cheap and unstrenuous way to develop a demand. His advertising having developed a demand, or at least a knowledge, he sends out his salesmen to the retailer to give the final pull necessary to land the orders—to transform this latent demand into tangible orders.

In Europe this course of procedure is well-nigh impossible. It can perhaps be worked in some cases and to some extent in England, but on the Continent almost never. And the reason why is very simple: The consuming public—the housewife who buys the breakfast food, the office worker who uses the typewriter, the factory foreman who wants the tools, the

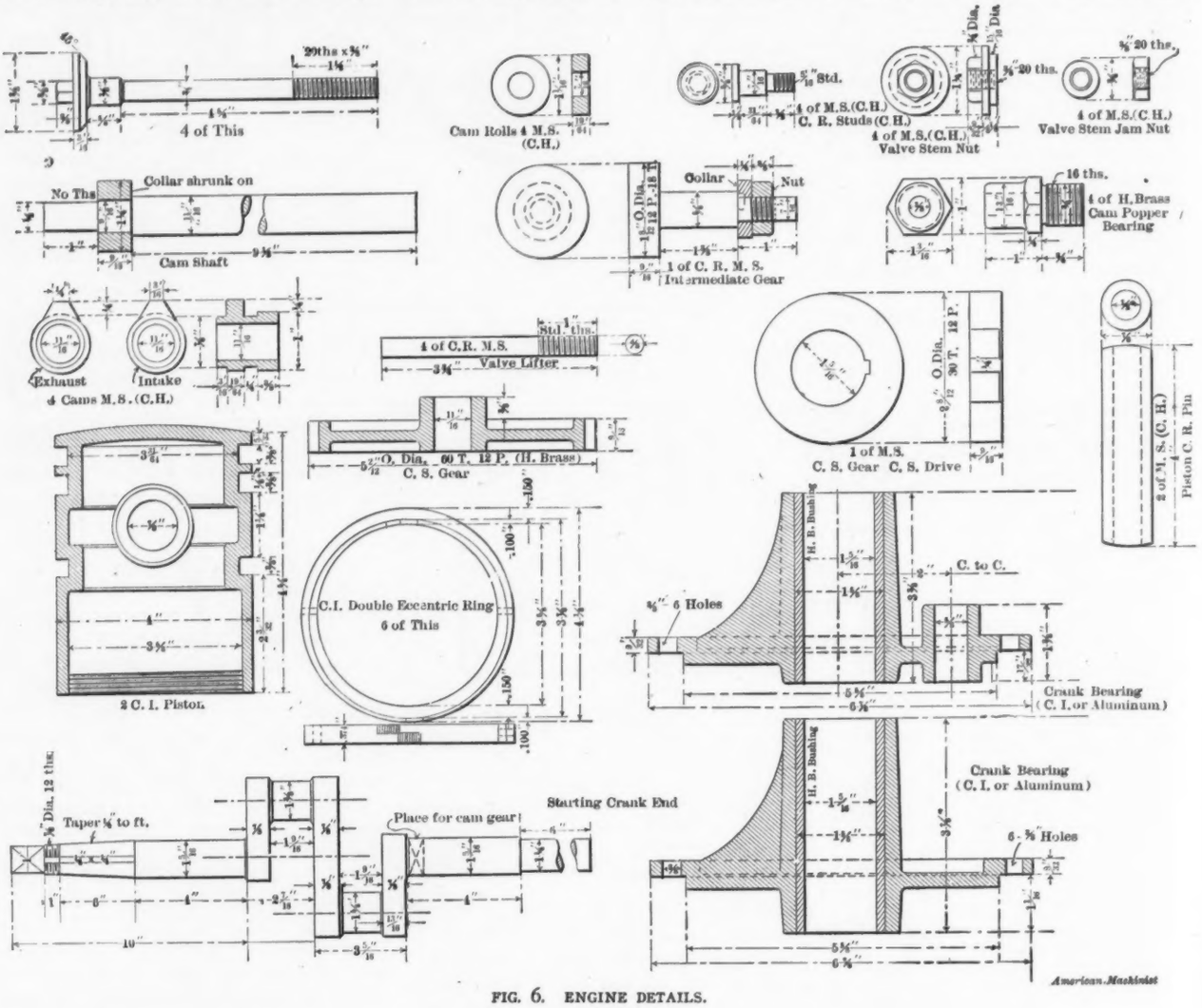

4 of This
Cam Rolls 4 M.S. (C.H.)
4 of M.S.(C.H.) C. R. Studs (C.H.)
4 of M.S.(C.H.) Valve Stem Nut
4 of M.S.(C.H.) Valve Stem Jam Nut
No Ths
Collar shrunk on
Cam Shaft
Collar
Nut
1 of C. R. M. S. Intermediate Gear
4 of H. Brass Cam Popper Bearing
Exhaust
Intake
4 Cams M.S.(C.H.)
4 of C.R. M.S.
Valve Lifter
1 of M.S. C. S. Gear C. S. Drive
C. S. Gear
2 of M. S.(C. H.) Piston C. R. Pin
2 C. I. Piston
C.I. Double Eccentric Ring
6 of This
C. to C.
Crank Bearing (C. I. or Aluminum)
Taper ⅛" to ft.
Place for cam gear
Starting Crank End
Crank Bearing (C. I. or Aluminum)
6 - ⅝" Holes
American Machinist

FIG. 6. ENGINE DETAILS.

*Abstracted from an article by Mr. Prentiss (of the Cleveland Twist Drill Co.), in *System*.

young dandy who wears the coat—these people do not read periodicals as do all classes here. The consumer cannot be reached through general advertising mediums. The soil is not ready to receive this kind of seed and grow a harvest from it.

This very simple train of thought the American business man apparently has rarely followed out. As a rule, he begins his campaign for foreign trade with advertising. He gets no results. He jumps to the conclusion that there is, therefore, no demand in the country for his goods.

Another common and equally fruitless method of starting a foreign trade is the plan of selling through the syndicate agents and salesmen. Such syndicate agents have the same weakness as general salesmen or jobbers in this country.

A serious mistake on the part of the American business man is that he does not realize the foreigner's attitude toward business, his commercial point of view. In Europe business is a vocation, not as in America, simply a means toward an end—the making of money. The Englishman, the German, is in business because he is thereby doing a service to the public, just as is the doctor or the government official, and he therefore deserves a certain reward for this service. It never enters the American manufacturer's head that he is manufacturing in order to help the world onward. He is doing it to make money, and as much as he can. If he is shrewd he gets his reward; if he is not, he fails to secure it no matter how much work he has done.

The European is thinking not so much of the profit, but rather of the work involved. He is conservative; he clings to old connections and goods. If he has bought from a certain jobber or manufacturer for many years, he will stay with him even at a slight money loss. This hold is strengthened by the fact that business is there more social, less commercial, than here. The buyer knows the selling house and the salesman; personally he is in the same class and social circle with them. When class and even caste lines are closely drawn as they are in Europe, closer personal bonds between individuals in the same class result. He has an inherent dislike for competition; it is distasteful to his temperament; it disturbs personal and social bonds between him and his fellow townsmen; it appears to him to sacrifice some of the dignity of his position. The result is that the two most significant phases in American commercial life, lower price and better quality, do not attract the European buyer. Why does he want to put in new goods with a lower price or higher quality, and assume the risk of pushing new goods? He has his trade, who will stay with him anyway; he cannot get the other fellow's. Putting in a new line of goods means considerable inconvenience and extra work for the dealer—a thing to which he is unalterably opposed.

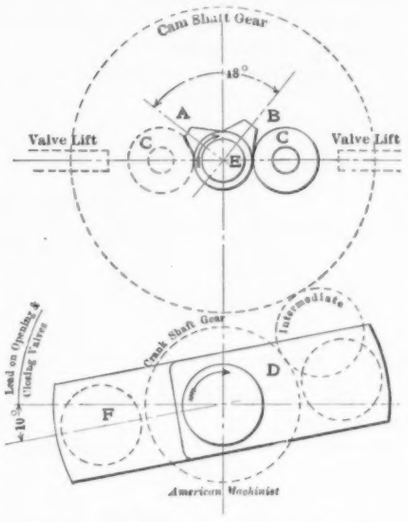


FIG. 7. DIAGRAM FOR SETTING VALVES.

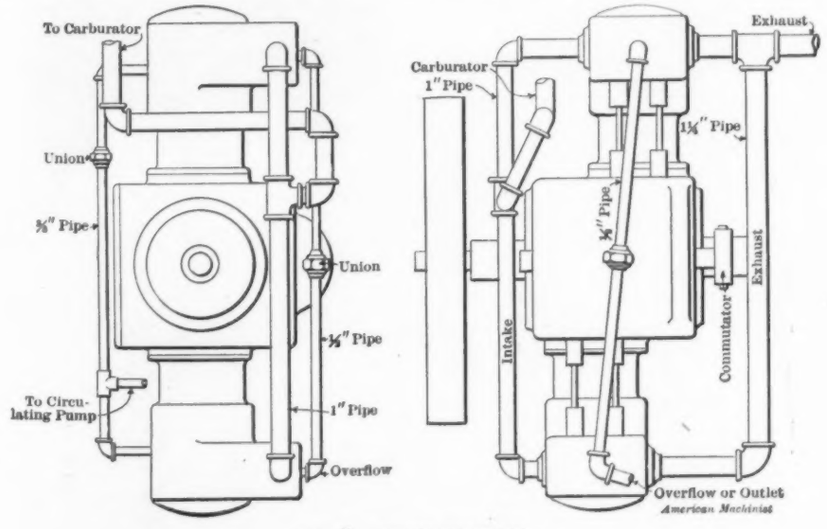


FIG. 8. PIPING DIAGRAM.

Not only does the American business man fail to grasp the attitude of foreign merchants, but he also fails to understand his customs and ways, his methods and terms. The consumer has the same characteristics, the same attitude toward business as the dealer. His point of view is widely different from that of the American consumer. He has not had the same training, the experience in buying which will enable him to feel a desire and to form his judgment merely from a printed description of an article. Often he has not sufficient discrimination to be able to decide between two similar kinds of goods. He will cling to old goods and old merchants; he does not want a change.

The American concern contemplating the opening of foreign trade should send some responsible representative abroad to look over the ground; if he be one of the principals, so much the better. Second-hand reports in a case of this kind cannot be made forceful or give a comprehensive description of the situation adequate for mapping out a campaign. This representative should study the situation sufficiently to be able to judge of the possible markets, of the classes to which his products will go, in what centers its sale will be concentrated, how extensive it will become, and through whom the exigencies of the case will require him to sell. Understanding the situation, he can make intelligent plans to meet it. His first temptation will be to establish at once a foreign agency with a foreign firm.

There are three reasons which should forbid this. In the first place it is difficult to make a selection. He will probably receive many applications on handsome letter-heads, praying for the privilege of acting as his representative. These are usually worthless, and, more than worthless, even dishonest at times; they often come from houses whose object is to obtain goods and money under false pretenses. In the second place, on account of the patriotism and conservatism described above, he will find it hard to get able as well as honest men to act as agents. His goods are not known, their value has not been tried, there is no demand for them. Naturally such an agency is not an inviting proposition to the stable business man. Thus, in all probability the exporter will either get a poor agent or he will get poor terms. Either is singularly fatal, for in Europe a change in agencies is not such an easy kaleidoscopic operation as in this country. Agencies are serious, permanent things. In the third place, if an agency is established before any trade is built up, the agent will rarely go out after business; that is not the accepted European style of doing business. In other words, he cannot be relied upon to build a trade.

The last two reasons are strengthened by the fact that Europeans are brought up with the "exclusive agent" idea. There the manufacturer does not sell his line to other dealers in his city or territory. The jobber always wants the exclusive selling rights; and the bigger the territory, the

better he likes it and the prouder he is. The words "Exclusive Dealers For" in his advertisements and on his letter-heads seem to tickle his fancy and to flatter his business pride. The real reason for this custom probably is that it lessens competition, for the result of it is that only one man in a town or territory can be secured to carry goods. Usually long-time contracts must be made with him, and then if he does not push the goods the exporter has no recourse.

The best plan is for an exporting firm to send one or two of its best agents into the foreign territory to work directly upon the consumer. It is not good policy to use foreigners for this work; they know the language and local customs, but they will have the same faults as the dealers: conservatism, prejudice, slowness. To make a fair trial requires a good hustling American salesman. And the characteristics of the typical American solicitor will guarantee him to be sufficiently adaptable to grasp new business systems and methods very quickly. He carries American adaptability, enthusiasm and dash with him, and these are worth more than linguistic or local custom knowledge.

Suppose these two agents are sent to England first, one to London and one to Liverpool. The best plan is for them to take orders from the consumer or user in such a way that they can be held; that is, that they need not be filled at once. After they have worked a month or two, the salesman can go to the local firm in London which the house has by this time decided it wants as the English representative, and say: "See the orders we have secured here. We have convinced these people that we have better goods and better prices than they have been getting. We have created a demand. We know our goods will satisfy and that the demand will continue. Do you want to be our medium for supplying the demand?" By this plan you kill three birds at one throw. You get the agent you want, and at your own terms. You have convinced the consumer and started a demand on his part for the goods. You have taught the foreigner something about your methods of getting business.

When the agent, who will of course be the exclusive agent for London or the whole of England, is established, allow these salesmen to stay and work for him for a time. Such a course will bring him orders, and therefore get him into good humor, pleased and enthusiastic over the goods. And it will be a course of instruction in salesmanship to him, he will become informed concerning the article, its talking points, particular value and superiority, for he must be taught this as much as any beginning salesman. He will learn to go after business in the American way.

But all the learning is not on the side of the foreigner; the American business man on his part must learn how his customers want to do business, what special line of goods they want, how they want their orders filled and their goods shipped, and what kind of terms they desire. He must act accordingly.

There are, therefore, four steps in the opening of foreign trade:

Getting the lay of the land and a knowledge of the situation.

Creating a demand among consumers—best by personal solicitation, sometimes by advertising or other means.

Appointing agents and teaching them the goods and selling methods.

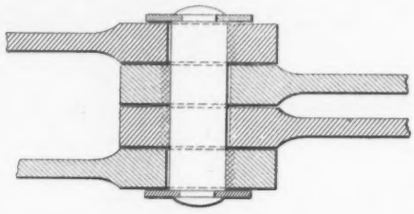


FIG. 1. COMMON DESIGN OF CHAIN JOINT.

Learning to please the foreign customer and consumer.

Foreign commerce takes time to build; it grows slowly; it requires the expenditure of much money. The exporter needs knowledge, courage and persistence. Although I have been considering this subject apparently as concerns commerce with England and the European continent only, yet what I have said applies to trade in most staple lines in every part of the world. For the American manufacturer will find that whether he is sending goods to China, South America or India, he is dealing with German or English merchants.

In a report recently issued by the Engineers' Society of Western Pennsylvania, we find the following:

"As indicating the strong financial position this Society has attained, the action of the Board last month in investing $7,000 in bonds is of especial significance. It is the first permanent investment the Society has made and included all entrance fees and Life Membership fees that the Society has received. Hereafter such fees will be invested and not used to pay current expenses. It is hoped that a larger number of members will purchase Life Memberships now that such a policy has been decided upon."

The *American Electrician* in its December number announces that, commencing with the new year it will be consolidated with the *Electrical World and Engineer*, the combined journals being thenceforth known as the *Electrical World*. The monthly journal will, however, be continued as the first issue of the month, these twelve issues being subject to a separate subscription for those who do not wish to pay for the weekly. The present editorial organization of the *American Electrician* will be continued.

Experimental Determination of the Relative Value of Short Bearings.

EDITORIAL CORRESPONDENCE.

It is a fundamental assumption, in machine designing, that the value of a bearing increases, other things being equal, in direct proportion with its length; a bearing of the same diameter, but half the length of another, being assumed to be capable of carrying half the gross load, the load per square inch of projected area which a bearing may carry being assumed

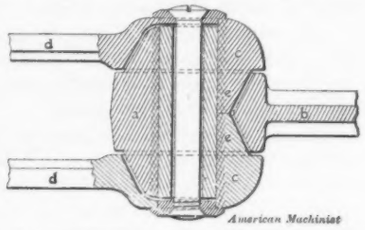


FIG. 2. IMPROVED DESIGN OF CHAIN JOINT.

as constant for all lengths. So far as known, this assumption has never been questioned or doubted, and yet some recent experiments by H. E. Hayward for the Link Belt Engineering Company show that, under the conditions of chain links, it is very far from the truth.

The small loads per square inch of pin area to which chains of the common pattern shown in Fig. 1 can be loaded with-

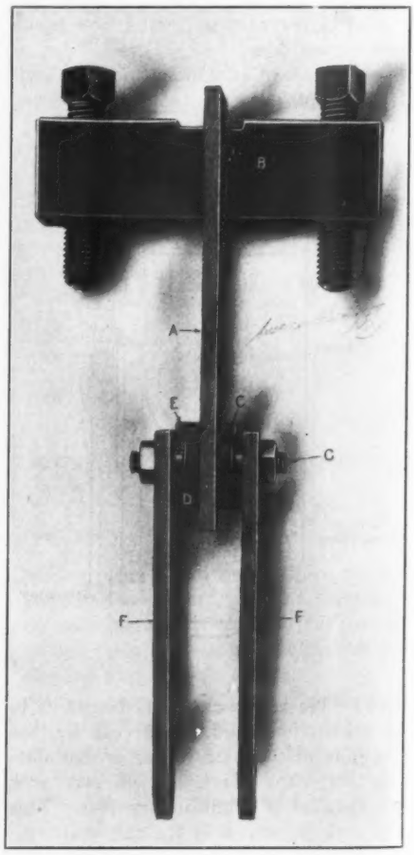


FIG. 3. CHAIN JOINT ARRANGED FOR TESTING.

out destructive wear taking place, has long been a puzzle. Although loaded far within the factors common in bearings in general, the life was unaccountably short, and in order to increase it, the chain joint shown in Fig. 2 was designed. The head *a* of link *b* is here extended on its bearing side, endwise of the pin, and projects within the heads *c* of links *d*. Meanwhile the heads *c* are extended at *e* on their bearing side within the head of link *b*.

It will be seen that for a given length of pin, twice as much surface is brought into play in Fig. 2 as in Fig. 1, and, according to the usual assumption, the value of the joint shown in Fig. 2 should be about twice that shown in Fig. 1. Its real value was, however, found to be far in excess of this, leading to the conclusion that the bearing value increases faster than the length. Continued experience served to strengthen this conclusion and ultimately led to an extended series of experiments to determine the law connecting the length and wear of chain-link bearings.

Fig. 3 shows a joint as arranged for a test. A link *A*, through the upper end of which a cross-bar *B* passes, has a slot through its lower end. The bearing *C* is held in link *A* between a block *D* and a key *E*. Links *F* carry the pin *G*, block *D* being of sufficient length to prevent the links *F* from touching bearing *C*. In the various tests the length of bearing *C* was varied.

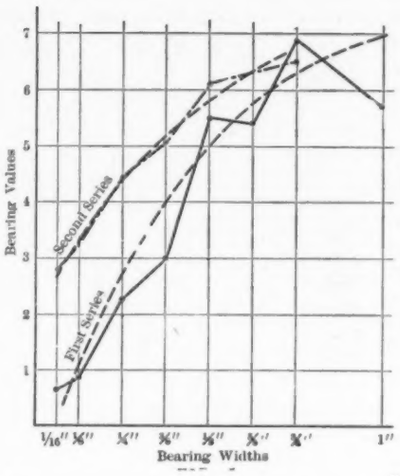


FIG. 5. RESULTS OF THE TESTS.

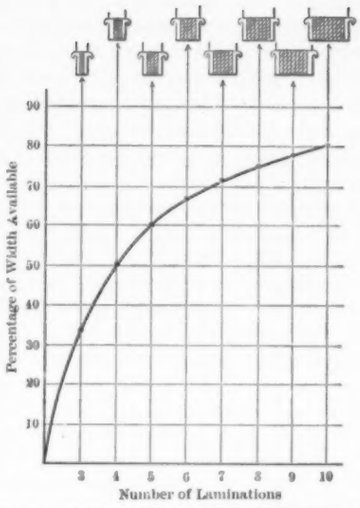


FIG. 7. PERCENTAGE OF THE EFFECTIVE AREA IN BEARINGS OF VARIOUS LENGTHS.

Fig. 4 shows the testing machine. The upper end of link *A* and the cross-bar *B* of Fig. 3 are similarly lettered in Fig. 4. Bar *B* is carried by a yoke *C*, which is caused to oscillate on its trunnions by the small motor in the background. Set-screws in the yoke, shown in both illustrations, enable the apparatus to be adjusted until the center of the pin of the joint under test is in line with the trunnions of the yoke. The lower links of the combination are loaded by adjusting the nuts *D*, the load being read by the spring balance in the foreground. A counter at *E* serves to record the number of oscillations.

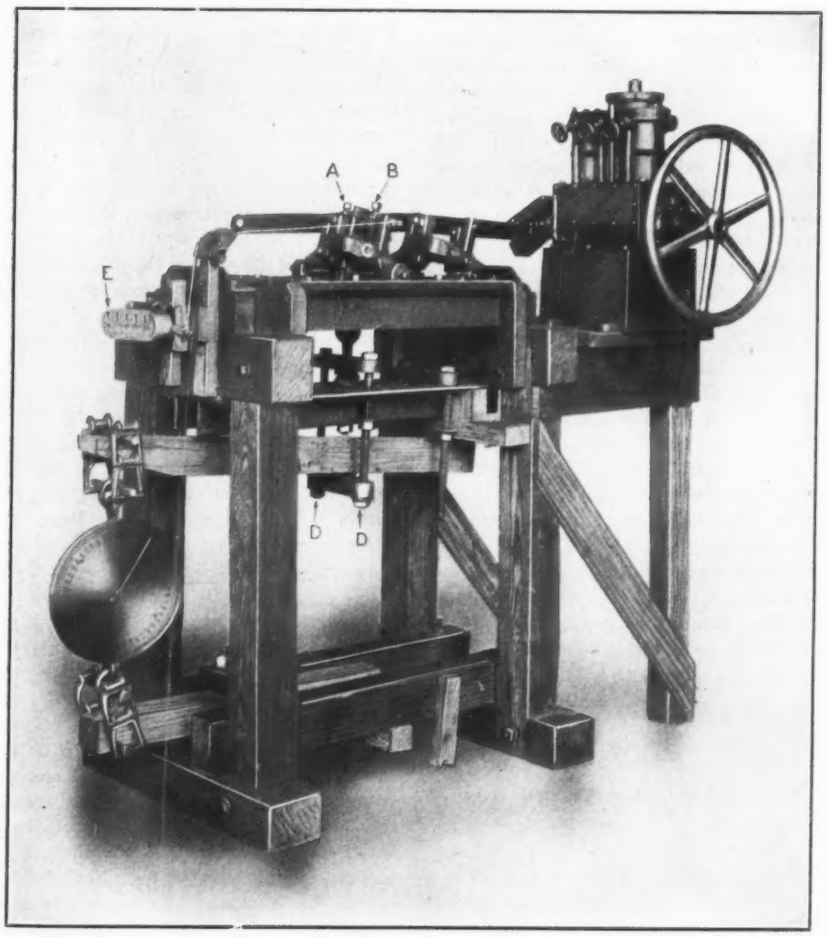


FIG. 4. THE TESTING MACHINE.

In the tests, bearings of various lengths were loaded under a constant load per square inch of projected area, and the apparatus was then operated until the bearing had so worn that the longest diameter of the hole was equal to one and a half times that of its pin, the joint having no lubrication, and the number of oscillations being taken as the value of the bearing. Two sets of experiments were made, the first with a hardened tool-

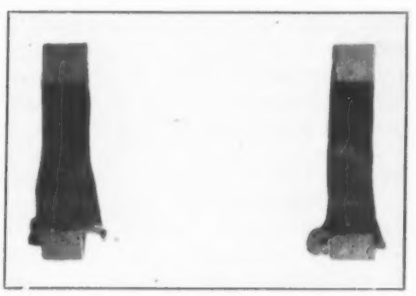


FIG. 6. CONDITION OF BEARINGS AFTER TESTING.

steel pin 3/8 inch in diameter, and with bearings of hard-drawn brass of 3/4-inch external diameter. The length of the bearings ranged from 1-16 to 1 inch, and the applied load was 1,000 pounds per square inch of projected area in all cases. In the second series, 3/8-inch hardened steel pins were used, as in the first, but the bearings were of cold-rolled steel, the range being from 1-16 to 3/4 inch, and the load was increased to 4,000 pounds per square inch of projected area. The object of this increase of load was to

reduce the time consumed. The first set of experiments consumed over three months' time, and with steel bearings under 1,000 pounds pressure, the time required would have been much longer. The angle of oscillation was 45 degrees, and the speed was 200 oscillations per minute.

Had the usual assumption been correct, the life of all bearings of a series would have been the same; but, on the contrary, a regular and rapid increase of life was found as the bearings increased in length. Fig. 5 gives the results in graphic form, the ordinates representing the length of life as measured by the counter. It will be seen, for example, that, although loaded with the same pressure per square inch, the ½-inch bearing had nearly twice the life of the ¼-inch and five times that of the ⅛-inch bearing.

Fig. 6 shows two of the bearings of ⅛-inch length, which, after testing, were cut in halves and the section surface polished. It will be observed that a pronounced feather has been formed on each side by the pressure and motion, the appearance and thickness of this feather being substantially the same for all bearings of the same metal, regardless of their length.

The explanation of the apparently anomalous results appears to lie in these feathers. If we conceive a bearing to be made up of a number of laminations of a thickness determined by the character of the metal and the load on the bearing, the laminations lying in planes perpendicular to the axis of the pin, the action would be explained. The layers of metal near the center of the bearing are supported by those beyond them; but this support diminishes as the ends are approached, the end layers contributing but little to the value of the bearing. The proportion of the lost effective bearing area diminishes as the length of the bearing is increased, and hence is most serious with short bearings. Fig. 7 gives, in the form of a curve, the percentage of effective area in bearings of from three to ten laminations wide—the form of the curve confirming the results of the tests. The action is the same with steel as with brass bearings, and perhaps the most striking feature of the tests is the one shown in Fig. 5, that with a steel bearing having a length of nearly three times its diameter, the curve is still rising at a considerable angle. F. A. H.

It is announced that the Aëro Club of America, an offshoot of the Automobile Club, will hold in the gymnasium of the Sixty-ninth Regiment armory in New York an aëronautical exhibition, which will include balloons, aëroplanes, box kites, and models of the most famous air ships of Europe and America, including those navigated by Santos Dumont, Roy Knabenshue and others.

Tools for Machining Segments.

BY EDW. SNYDER.

In the manufacture of a certain mechanism, it became necessary to devise methods of machining the various parts shown in Figs. 1, 2 and 3, so that they would be interchangeable. Figs. 1 and 3, as will be noticed, are end views of Fig. 2.

A is a shaft of ⅜-inch bessemer rod, shouldered at one end to 5-16 inch. *B* is a segment of a gear of 32 pitch, 48 teeth, ¼-inch face; on account of the closeness of other parts of the mechanism, it was necessary to keep the hub as small as possible. *C* is a segment of a gear of 32 pitch, 40 teeth, 3-16 inch face. *D* is a segment with seven slots *a*, spaced ¾ inch apart on the periphery, with lugs at *b* and *c*, Fig. 3. *E* is a segment of a gear, 32 pitch, 48 teeth, 3-16 inch face, with a ½ inch hub, which supports segment *D*. *F* is the male part of a coupling or clutch. For machining these parts, and for locating and drilling them on their shaft, I designed the tools shown in the remaining sketches.

A SEGMENT HOLDER.

Fig. 4 shows the device used for boring and reaming the hole and cutting the seven notches in part *D*, Fig. 3. The shank is 1 inch in diameter, and at *G* is a gray-iron plate, which is fastened with six screws *d*. *H* is a stud, removed during the boring and reaming operation. *I* is a plate which holds the work *D* in place, the work being gaged by thin plates *J*, fitting between the arms of the segment. At *e* and *f* are two clearance holes for lugs *b* and *e*, Fig. 3. Screws *g* are slightly loosened for segment *D* to be in position; then plate *I* is passed over the heads of screws *g* and given a short turn to the left; the lug *b* meanwhile being held against the flat side of stop-pin *h*, which is flush with the face of plate *G*. The casting *D* is then bored and reamed, and one end of the hub is faced so that it will be a given distance from face of plate *G*. The opposite end of the hub is faced in a drill press.

To cut the spaces and finish the periphery, the stud *H* is replaced and the fixture placed on index centers in either a gear cutter or milling machine. Segment *D* is again placed in position, and the slots and periphery finished at one operation by means of a formed cutter made for the purpose, the cutter milling half of the blank space at either side of the slot.

SPECIAL CHUCK JAWS.

Fig. 5 shows a type of chuck jaw used when finishing the hole and hubs of the parts *B*, *C* and *E*, Fig. 2; three pairs are used, the general construction being the same in all. They are fitted in a two-jawed Cushman chuck. The bodies *K* are of gray iron and the five plugs *L* of drill rod (5-16 inch) placed in position before the jaws were bored. The plugs were allowed to project inside of the circle of the hub and segment part about 1-16 inch, and the jaws were bored out at *i* and *k* about 1-64 inch in radius less than the finished size. Then the two inverted V's at *l* were turned, and also similar V's formed at *i*. The plugs *L* were then numbered and driven out, and the inverted V's on the gray-iron parts were turned off, leaving the jaws a good fit for the segments they were intended to hold. The plugs were hardened on the end where they gripped the segments and replaced in the jaws.

The jaws hold better than if they gripped on the full circle, as they have a better bite. I have used the same construction, *i. e.*, gray-iron body and steel teeth on larger work, and it has proven entirely satisfactory and more economical in construction than solid tool-steel jaws. In larger work it may be necessary to tap out the end of the steel plugs and hold them in place with a screw through the shank, as they are liable to pull out if a tool should happen to catch and loosen the casting or forging being operated upon.

CUTTING GEAR SEGMENTS.

Fig. 6 represents two views of the style of arbor used for cutting the segments *B*, *C* and *E* (Fig. 2), there being one arbor for each segment. The shank is reduced at the end *M* to the size of the hole in the segment it is used for, and carries the body or backing *N* for the segments; *O* is a clamp or plate to hold the segments in position, two being cut at one handling. The screws through this plate being loosened, part *O* is removed and the segments placed in position, the hub of one being inside of body *N*, and the hub of the other being at the outside, thus bringing the two flat surfaces of the segments together. When clamp *O* is placed in position and the screws tightened, the end *M* is forced against the end of the segments on account of the conical pointed stud under the clamp having a bearing at one side only of the depression in the face of *O*. This results in the other end of the segments being forced against the end *N* of the clamp. A small projecting lip on the clamp at this point and on the opposite side of the center holds the segments against the face of *N*. Very little pressure is required on the clamp screws, these having no tendency to work loose. The surface at *o* clears the cutter, and as the work is indexed only part of a full circle, the part projecting beyond the circle *o* continued, does not interfere with the cutting of the segments.

Fig. 7 is a style of gage used for testing the cutting of the segments *B*, *C* and *E*. The base is of machine steel and was stamped *before* boring the holes for the two studs, which are of tool steel hardened on the upper end. The hole in the center of the base is a "sight" hole to allow the workman to observe the tooth contact more clearly. The style of cutter used for the segments is shown by Fig.

8. The cutters are so constructed that the part that trims the top of the tooth overlaps the previous and next cut about 0.005 inch, consequently the segments are not turned on the rim, but are cut to size with the same cut that finishes the teeth. Part *F*, Fig. 2, is straddle-milled at one end, and is held in a pair of milling-machine vise jaws counterbored to receive it.

THE LOCATING AND DRILLING JIG.

For locating the segments correctly on the shaft and for drilling them in place the jig in Fig. 9 was designed. The sides *a* and *a'* were made of machine steel finished all over; after being planed they were doweled together and the edges finished as though they were one piece, and holes for screws and dowel pins that had the same relative position in each were drilled while they were doweled together. The half-round groove *b*, near the top lengthwise of one of the sides *a'* forms one-half of the bearing for the hinge pins, which are drive fits in the swinging binders *c*, *d* and *e*.

The bottom of the jig is made of gray iron, as are also the the ends *f* and *g*. End *f* carries the guides for clutch *F* (Fig. 2), and the bushing for the drill for the hole through the clutch is a drive fit in *f*. Supports *h*, *i* and *j* are of unannealed tool steel and carry shaft *A* (Fig. 2) while it is being drilled. In making the fixture it was especially desired that the shaft bearings should be in line and of the same height. So the slots for the bearings were milled with a ⅜-inch convex cutter made to "wabble" 0.001 inch, and while being milled they were clamped against an angle plate with a stop stud bearing on one end. The 3-16 inch radius in binders *c*, *d* and *e* were milled at the same time, gaging from the same stop stud.

These swinging binders were finished to size (except the holes), with the ⅜-inch groove milled in the bottom; they were placed in position in the jig and the holes for the latches *k* were transferred through the holes previously drilled in part *a*; the holes for the hinge pins were likewise transferred, the drill being guided by the slot milled in *a'* and the parts which complete the pin bearings. Bush plate *l* is of machine steel and is fastened to *d* by two screws, which were shouldered and fitted in recesses. When the tapped holes in *d* were drilled they were located so as to draw the shoulder under *l* firmly against the side of binder *d*. The two bushings in the plate guide the drill for pin-holes through segments *C* and *D*, Fig. 2.

The caps *m*, of which there are six, are of machine steel; they were milled, drilled and countersunk all in one piece, then cut apart. Spring latches *k*, of which there are three, are of ¼-inch drill-rod hardened on the beveled end. Each has a thumb piece of ⅛-inch drill-rod for releasing latch. Racks *n o p* are of tool steel, hardened, have 32 pitch teeth on one edge, and are pivoted on shoulder screws. The tool-steel and hardened block *q* forming the gaging point against which one edge of the first slot in segment *D* (Fig. 2) rests, was adjusted to the model segment.

ASSEMBLING THE JIG.

In the making of the jig the sides, ends and bottom were screwed and doweled together, then parts *h*, *i* and *j* were placed in proper position and the correct height from the bottom obtained by means of a pair of ⅞-inch parallels, and blocks of the correct length gave the proper location endwise; the holes for the screws and dowel pins were then transferred through the holes previously drilled in the sides, and the blocks and parallels were then removed. A ⅜-inch shaft was placed in the slots in *h*, *i* and *j*, then the binders *c*, *d* and *e* were placed in their proper position, a slight tension was brought to bear on each end of the binders, when the holes for latch and hinge pins were transferred as described before.

The model was placed in the jig and the binders closed and latched. The edge of the first slot in the segment *D* was forced against stop *q* and the racks *n*, *o* and *p* were held in place against the model segments *B*, *C* and *E* by means of the adjusting screws shown, and while they were thus held the racks were rigidly clamped against bearings *h* and *i* and end wall *g*. The jig was then dissembled and the holes for the shouldered screws for the racks

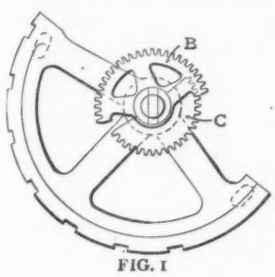


FIG. 1

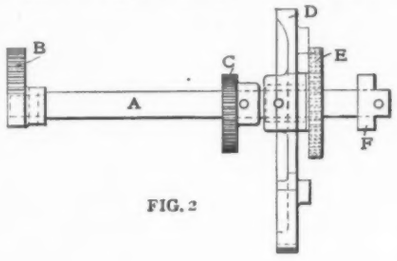


FIG. 2

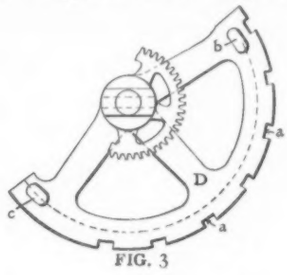
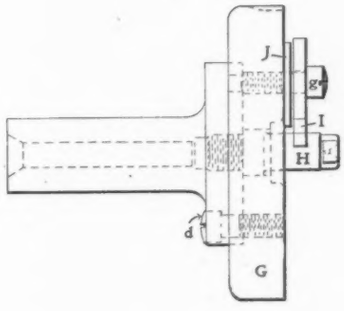


FIG. 3



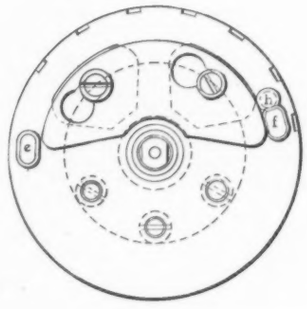
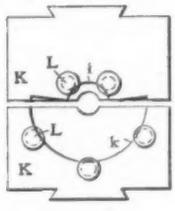


FIG. 4



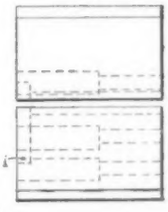
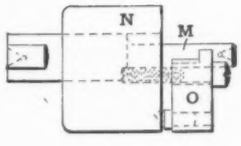


FIG. 5

FIG. 8



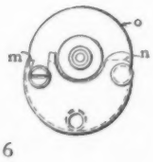
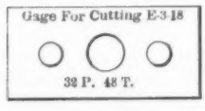


FIG. 6



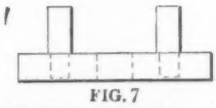


FIG. 7

American Machinist

TOOLS FOR MACHINING SEGMENTS.

were transferred into the supporting plates through the holes previously drilled in the racks. It will be noticed that the plain parts of the screws project into the plates, about ⅛ inch; this was done to avoid any error due to the thread not being in line with the hole, an error commonly met with where close work is required.

USING THE JIG.

The foregoing explanation of the jig will perhaps be more readily understood by going through the operation, figuratively speaking, of placing shaft and segments in position for drilling.

away from the segments by means of springs, as shown.

The binders are next lowered, a series of pins (not shown) preventing them from being latched unless the work segments are correctly placed, radially, within at least one-half of a tooth space. After the latches are in place pressure is brought to bear on the end of the clutch *F* and shaft *A* by means of screw *t* at the right-hand end of the jig, bringing the plain face of the clutch against the side of *h* and *c*. The screw *u* at the other end of the jig is next brought against the flat side of segment *B*, which is gaged endwise

proceeded with; the adjusting screws *v*, *w* and *x* are brought to bear on the backs of racks *p*, *o* and *n*, the teeth of which are thereby meshed with segments *B*, *C* and *E*, and screw *y* is brought against the end of segment *D*, forcing one edge of the first slot in this segment against the projecting lug or tooth on stop *q*.

The drilling of the four pin-holes through the segments, clutch and shaft is then proceeded with. The pins used are straight and made a drive fit. It should be stated that the segments were a "wring fit" on their respective places; in placing the segment shaft in the frames where

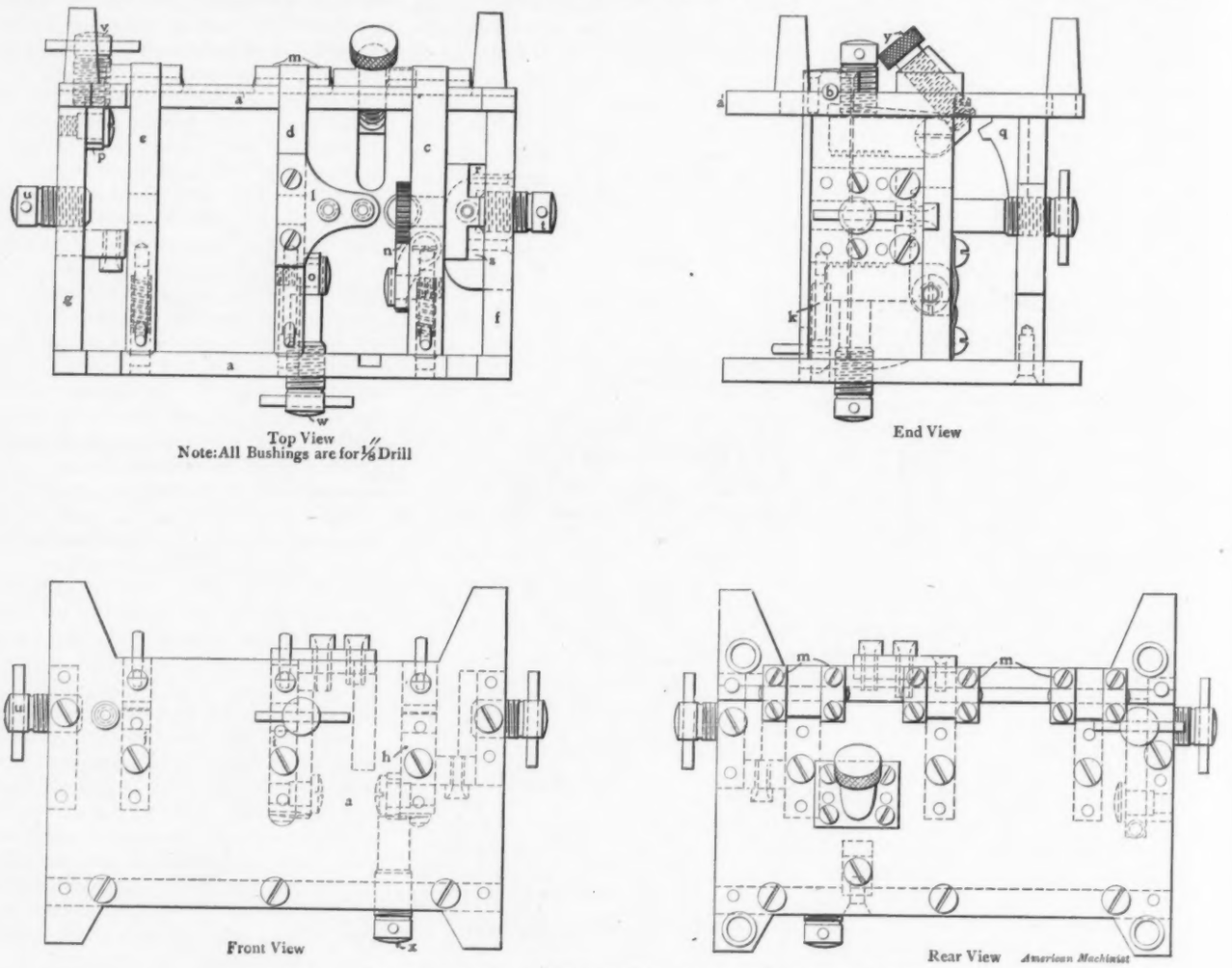


FIG. 9. JIG FOR LOCATING AND DRILLING SEGMENTS ON THEIR SHAFT.

The various clamping screws are run out a few turns, the latches pushed back and the binders raised. The segments and clutch, already assembled on the shaft in approximately the correct relation one to another, are placed in the jig, the work-shaft *A* having a bearing in the slots in *h*, *i* and *j*. The clutch *F* is held in the correct position by the two guides *r* and *s*; the large segment *D* is gaged by the edge of the first space bearing against the projecting lug or tooth on *q*; the gear segments *E*, *C* and *B* are gaged by the racks *n*, *o* and *p*. While placing the shaft and segments in the jig the racks are held by the shoulder on shaft *A*. Next a thin U-shaped wedge is placed between segments *C* and *D*, and straddles shaft *A*; the wedge forces *C* against the sides of bearing *i* and binder *d*, and *E* against *h* and *c*. It will be noticed from Fig. 2 that the end of the hub of segment *E* does not extend quite through the hub of segment *D*, therefore the wedge takes a bearing against the end of the latter and forces both segments into their proper positions endways.

The segments and clutch being located on the shaft axially in their proper positions, the adjustments radially are then used it is necessary only to remove the segment *B* and clutch *F* after they are drilled.

On account of the heat in India the passenger cars have double roofs, the one from 2½ to 8 inches above the other; and the upper roof is continued down the sides of the car about 28 inches, forming, as it were, an awning over the upper part of the windows. Another peculiarity of first- and second-class cars is a servants' compartment at each end, as almost every European passenger takes at least one servant with him.

Turret Lathe.

The half-tones illustrate a turret lathe in which are embodied several interesting features. The machine, as shown in Figs. 1 and 2, is set up for small gasolene engine flywheels. The carriage is provided with a turret for the boring operations and two cross-slides, one carrying the tools for turning and facing the rim of the flywheel, and one carrying the tool for turning the pulley, which in some cases is cast integrally with the flywheel. This second slide-rest is provided with a forming attachment to crown the pulleys. The feed is by means of a nut carried by the apron and traveling on a coarse-pitch stationary screw. This nut is made long to minimize the wear, and the screw is reversible, so in case one side of the thread gets badly worn, it may be reversed and give one the advantage of a new lead-screw. The nut is driven from the feed rod by tumbler gears as shown in Fig. 3, and the start, stop and reverse are obtained by means of one lever. The handwheel is connected to this nut by means of spiral gears.

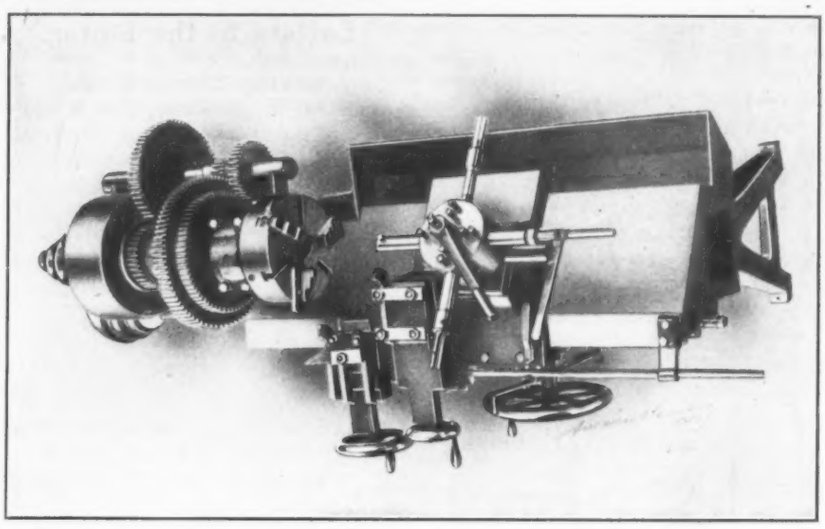


FIG. 2. TURRET LATHE.

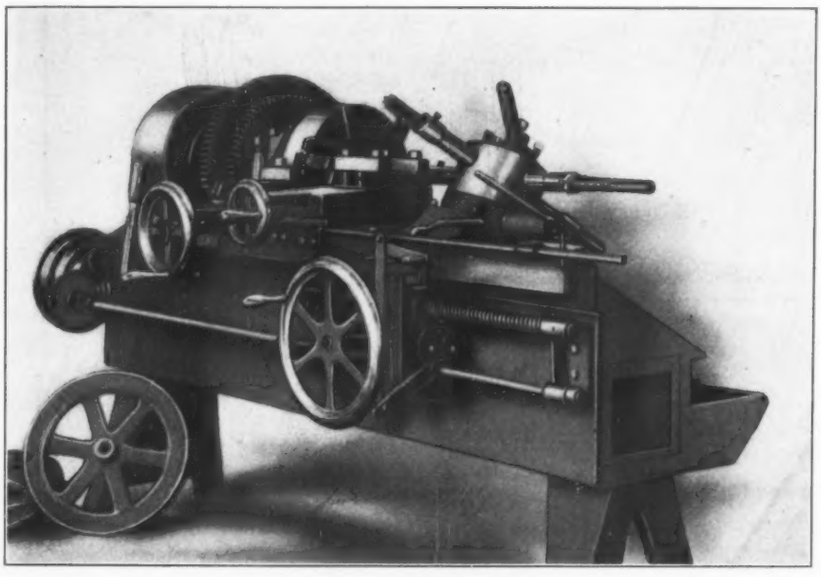


FIG. 1. TURRET LATHE.

The bed is in the form of a closed, nearly square tube, although the top is inclined in order that the chips may slide off into the pan at the rear. The carriage bears on the rectangular way at the front and the top of the bed, and the cross-slides are supported by the flat ways shown, the upper part extending out over the lower one, so that chips cannot fall upon the bearing surfaces. The spindle is 6 inches in diameter, and has a 3¼-inch hole clear through. The machine as here represented, has but three speeds, one direct and two back-geared, all of them being secured by the lever at the right of the headstock. The latter is cast in one piece with the bed. The driving pulley is 16 inches in diameter for 6-inch belt, and the lowest back-gear ratio is 12 to 1. This head, however, is a special one, the regular head having eight changes of speed, which, with the double speed countershaft, gives sixteen speeds, arranged in geometrical progression. The machine is also built with a gear box for the feed, in place of the cone pulleys shown. The Moline Tool Company, Moline, Ill., is the builder.

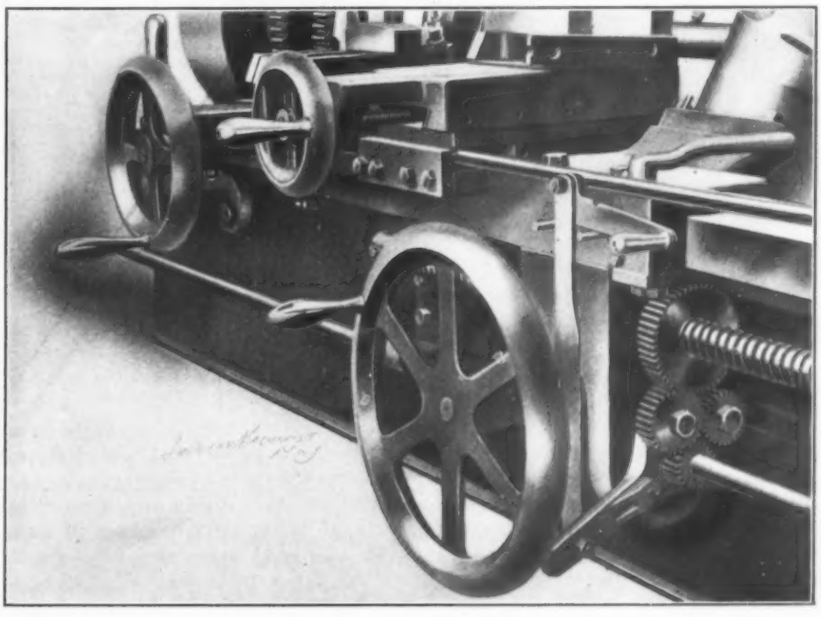


FIG. 3. TURRET-LATHE CARRIAGE.

A Question of Delivery and of Interest on Delayed Shipments.

All sorts of questions relating more or less directly to the business of machine production are referred to us for settlement, and naturally we are glad when we can be of service in this way; but it is not always possible; and among the other things we have learned by experience is not to attempt to sit in judgment in cases where people disagree, especially when the disagreeing people are pretty sure to

know more about the subject matter of their disagreement than we do or can. Nevertheless, there are certain questions arising which need to be discussed, and a machinery dealer recently propounded one of these which we hereby submit to our readers who may be interested in it. He writes substantially as follows:

It is the custom of certain manufacturers to invoice machines to the dealer as soon as they have them completed, even if attachments to be supplied by the dealer have not been received, and if, consequently, the machine cannot be shipped. To this custom I take no exception provided the date of invoice is not prior to the date of the promised delivery. Some time since, we ordered a machine for a customer, which machine was to be finished in five months—*i. e.*, this time of delivery was given when the manufacturers quoted the price. We had an expensive motor in their hands prior to the date when they were supposed to be ready for it, so as not to keep them waiting, and a period of five months elapsed after the promised time before they shipped the machine. Thus we had certain funds tied up for a certain period of time due to the failure on the part of the manufacturer to ship the goods as promised.

Now, it is my opinion that if it is fair for the manufacturer to invoice his goods on completion, and at times before the dealer can use them, it is fair for the dealer to charge interest on his investment if the manufacturer fails to utilize promptly the goods that the dealer provides. Is it fair or is it not?

Recent high-pressure tests made on the experimental locomotive at Purdue University by Prof. W. F. M. Goss indicate the inadvisability of working pressures above 200 pounds. At 240 pounds serious difficulties were encountered with the operation of the injectors, check valves, etc., while many parts and fittings normally tight at about 200 pounds pressure and less, commenced to leak steam.

Letters to the Editor.

Making Things Work.

Referring to the device that failed, by J. M. Megenus, at page 506, having had some experience in piston turning of various sizes up to 30 inches diameter, I would say that I have turned two 22-inch steel pistons on one mandrel a good many times, and have not had any great difficulty in doing so. I here show a way of getting out the job.

Fig. 1 shows the mandrel, which is turned down in the center of taper so that the piston-head bore fits each end, thereby being more rigid and holding much better. Have also done away with what I consider the most faulty part of Mr. Menegus' mandrel, viz., the small end for the carrier.

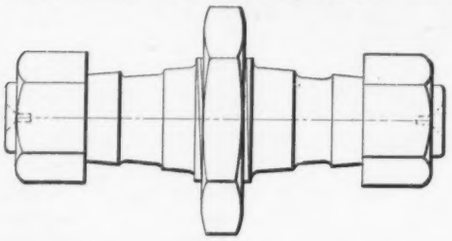


FIG. 1

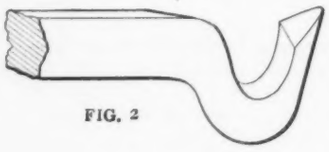


FIG. 2

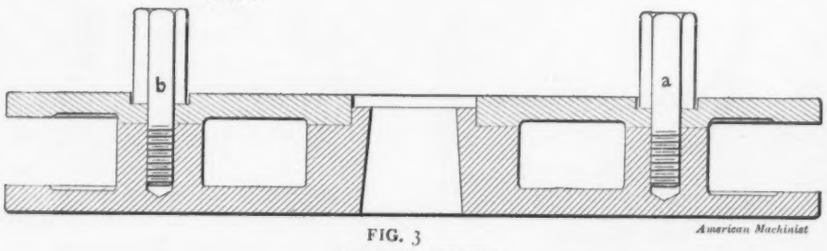


FIG. 3
TURNING PISTONS.

Fig. 2 shows how the piston is driven. By taking out two of the tap bolts and substituting special long ones *a b*, to be driven by small angle plates, the two pistons can be comfortably driven. I should also take care to get as near as possible to the face-plate, so that the whole job is as compact as possible, thus lessening the tendency to strain the drivers.

Fig. 3 shows the roughing tool I use for the job, and find it very satisfactory. It reduces the cutting surface to a minimum, and therefore the cut can be increased without chatter. They also last a considerable time before requiring to go to the toolsmith to be reforged.

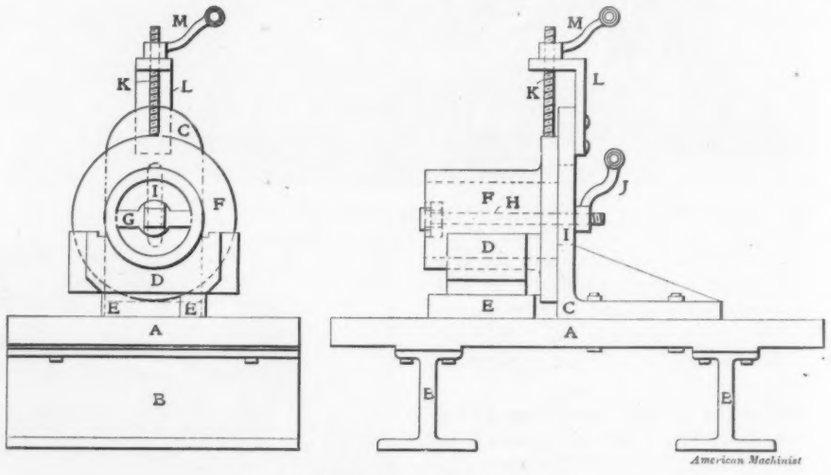
The tool-posts used are separate, and can be set at any distance required.

Mr. Menegus is not the true mechanic he fancies, for instead of persevering and doing his best, using his brains in the right direction, he sets out to give the job a knock-out blow and spends the rest of his time in complaining. We have one or two good youths that I fancy would give him ideas in general engineering.

A BRITISHER.

Babbitting Jig for Large Journals.

I designed the arrangement shown in this illustration for babbitting roll and pinion boxes on account of the extra labor required and the inconvenience caused by having to clamp these heavy boxes to the necks of the rolls when using the neck or journal for a babbitting mandrel. This was not an easy matter, as the boxes weigh from 200 to 500 pounds each. The operation of the rig will be understood from the sketches with but little explanation. *A* is a heavy gray iron plate, planed on top and mounted on supports *B B* about a foot high; it should be made perfectly level in all directions. *C* is a heavy angle plate planed true and bolted to *A;*



ROLL BOX BABBITTING JIG.

D is the box to be babbitted, resting on parallel strips *E E*, which are necessary only in cases where the box is so thin that the flange of the mandrel will strike the base before coming to its proper position. *F* is a hollow gray-iron mandrel corresponding with the neck of the roll and having a flange on the inner end wide enough to cover the face of the box. A crossbar *G* is cast across the front end of the mandrel, through the center of which is planed a recess into which the head of the bolt *H* enters to prevent its turning. This bolt passes through a slot *I* in the upright

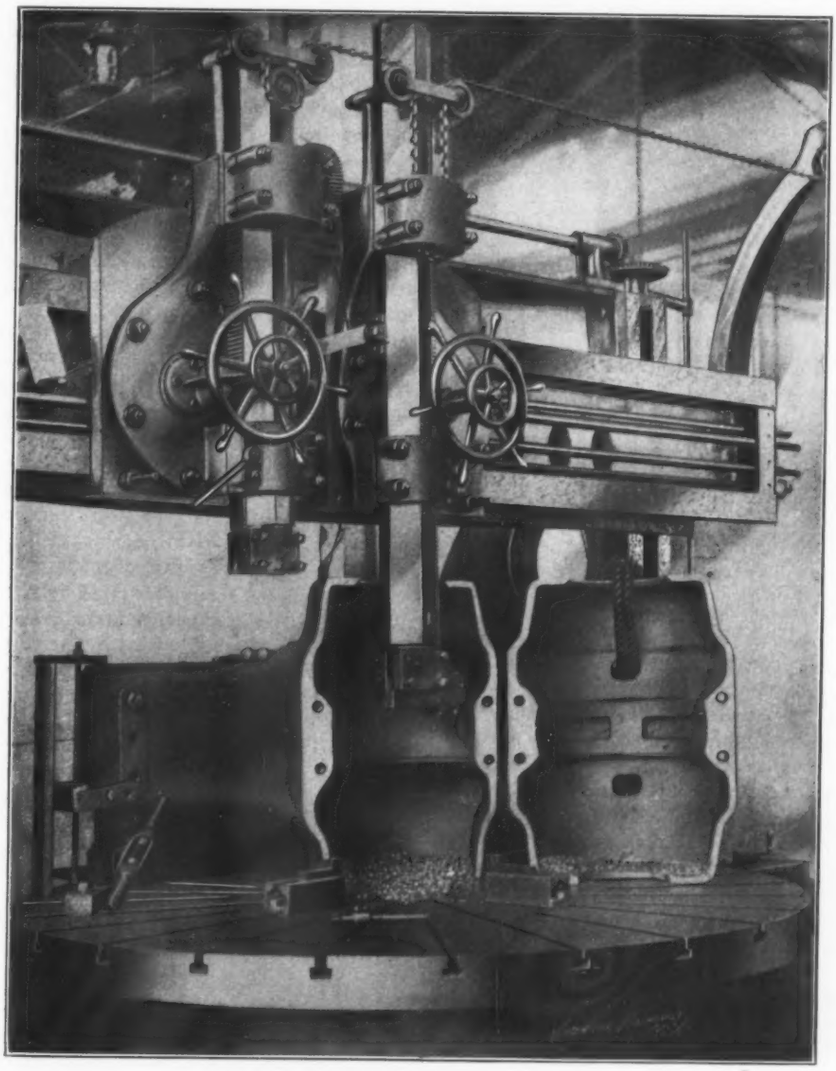
leg of the angle plate to which it is clamped in its various positions by the lever nut *J*. *K* is a stud attached to the flange of the mandrel and passing through a bracket *L* which is secured to the top of the angle plate by rivets. The mandrel is raised and lowered with the lever nut *M*.

The metal is poured from the side and is prevented from escaping in front by a whole or half ring, not shown. This fixture is in use every day and is all that can be desired for this class of work.

Steelton, Pa. J. J. NEWBAKER.

Boring Spherical Seats for Bearings.

Unless I am mistaken, it was in your journal some months ago that I noticed a description of the method employed at the Allis-Chalmers shops, at West Allis, for boring out their large sizes of spherical bearing pedestals. As this rig was entirely different from the one used in their shops at Cincinnati, I enclose a photograph of a bearing pedestal in position on the boring mill after having been bored to 27 inches diameter true in radius and diameter within .002 inch. With this rig, which is simply a link connecting both bars, the left-hand head is held rigid, while the right-hand bar is fed through the bore in the usual way, sliding the cross-shield back and forward with it. The operation takes about the same time to complete as though the holes were straight instead of spherical. G. R. L.



BORING A SPHERICAL SEAT IN A PEDESTAL.

Lathe Design and Practice.

Since my articles on "Lathe Design and Practice" have stirred up comment they have served the purpose for which they were written. A great deal more might be said on the same subject, but it seemed to me that I was near the limit that your readers would wish to hear from any one man. But, since you have a supply of scissors and blue pencils on hand, I will offer a little more and, if it bores your readers, divide the blame with you.

Adverse comment has been made on the use of Woodruff keys for fastening change gears in place. Any trouble about the key falling out can be very easily obviated by the builder if he will do as in Fig. 1, file a slight mark on each side of the key just where it goes into the shaft and stake the metal in. It is a little bother, but no more than everyone does with a square key, and it saves lots of hard words at the other end of the line. Fig. 2 shows another scheme for keeping change gears from working off, which I have never seen described in print. I suspect it is the invention of our friend Walker of magnetic-chuck fame. The key is pinned in place to keep it from falling out, and is deep enough to bear on the tapering part of the head of the nurled-head screw *a*. Setting up the screw with the fingers presses the key out hard enough to keep the gears from slipping off. Of course there is no side thrust on a change gear to force it off, and anything which keeps it from jarring off is enough. Necessarily, some way of getting the slots in all the gears the same depth is necessary, but it is not an expensive affair and there is nothing to lose or misplace and no wrench to hunt up.

Art Isan suggests turning the lathe spindle box, which I offered the other side up. I do not suppose that it would make any perceptible practical difference in the wear, though I still think my plan the best theoretically. Moreover, it is easier to place the adjusting screws where I do on a back-geared lathe, on account of the back arm. I do not exactly see what he means by driving in a round box. If we take a half-round box and turn it larger than the bore of the head and drive it in, it simply closes up a little, but is not noticeably tighter than if it had been turned to an exact fit. They have always to be secured in place by some other means than driving. The harder they are driven in, the harder they are to scrape to fit or to ream.

I once had an idea that if we could have a nice round hole in the headstock and fit a nice round half-box to it and then ream a nice round hole in the box, a nice round spindle would make a nice fit. Well, we paid out quite a lot of money and we obtained a fit, but not the kind we were looking for. We saved enough scraping so that it paid, but we were disappointed about having to scrape at all. The trouble seems to be that when the caps on a lathe head are screwed down to ream the boxes, liners must be put between the boxes or they must be brought brass to brass, and this produces a different distortion from that produced when the pressure is partly brought on the spindle and the liners are left out or the brasses filed apart. Then, when the job is scraped up to suit, let another man come around and tighten down the caps a little harder or a little easier, and the job will look like thirty cents.

With the wedge-adjusted box just as bad conditions may be obtained, but they will not be because it is too much bother to monkey with the adjusting screws, and the box gets a chance to wear well. The very best thing I ever tried was a solid box without any possible way of taking

up wear, and, as I have stated in a former article, it will not wear if it is not adjusted and does not meet with any other serious accident.

I remember showing your correspondent, Horace Arnold, a lathe with solid boxes which had run for years without perceptible wear, and found that he believed the same thing himself. He suggested that we should have some means of rotating the box a little every once in a while, so that the wear should be equalized in all directions, to which I took exception that since it seems to be possible to confine the wear to the lubricant and keep it off the metal, rotating the box would be superfluous. But to suggest to a lathe builder that he should put such a box on a tool would be futile, since he has to sell as well as build lathes; and the next best thing is to suggest something enough like present practice so that it will sell well and yet be as close in effect to a solid box surrounded by solid metal as possible, and either Art Isan's or my method would do both. As for having the cap hooked over, I doubt if it makes much difference. It would if the cap were not bolted down tight, but as it is it reminds me of the practice of a large manufacturer of flange couplings, who figures the bolts so as to give sufficient friction between the surfaces to drive, regardless of the shearing strength of the bolts. Similarly in this case, the friction between the surfaces ought to be sufficient.

Speaking of the various experiments used to check chattering in the older and lighter lathes, I would suggest that some of the vibration is due to similar causes to those in a violin string. As usually played, a violin string vibrates as a whole. We do not seem to get this condition on a lathe very often, but if we lightly touch a string with one finger at certain spots, and bow it gently at certain other spots, we get the harmonic vibration with the string vibrating in short lengths. The slightest change of position throws these harmonies out or changes them to other harmonies. So when we have a piece of work vibrating in the lathe, the slightest change of any of the conditions may stop its vibrating or change its vibration, though here we have the additional difficulty that at each revolution of the work the old chatter marks come upon the tool to vary the cut and make it more difficult to check. This will explain Art Isan's success with a bit of leather or waste under the dog, but his trouble (which we all have) when running up a cut an inch or two, and it begins to chatter, is a good illustration of my statement as regards balance of faces. When we start a cut at the tailstock, the pressure of the tool is transmitted directly to the tail spindle and no vibration is likely, but as soon as we begin feeding we have the tool pressure divided between the tail center and the head center, and if the head spindle is not solidly held, or the center rests or follow rests are not sufficiently stiff, we are sure to get chattering, due to the unbalancing of the faces acting on the work; for it is not alone the pressures exerted, as Art Isan seems to think, but their location which determines whether they will balance or not.

His scheme for putting the cross-feed screw under tension both ways is first

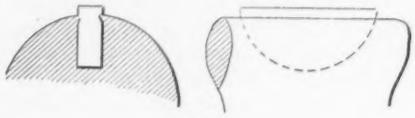


FIG. 1

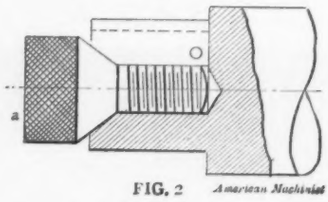


FIG. 2

LATHE DETAILS.

rate, but his collar *a* is as superfluous in his case as it is necessary in mine. As to a choice between having the screw under tension when turning outside and facing toward the center, or for boring and facing away from the center, I should prefer the majority rule and take the first.

Finally, about the cross-feed screw in one of my figures having a right-hand thread, of course, I might say that when we build lathes with two tool blocks, one in front and one back of the work, we put in a right-hand screw for the latter and that this was one of them, but I prefer to own up that this is just one of the common or garden variety of mistakes.

E. H. FISH.

The articles by Mr. Fish and the comments by others on this subject are interesting and instructive, and there is need for much more information and discussion on the subject now, as the advent of high-speed steels has made it necessary to have the standard lathes very much stronger and heavier than now, and as this will require new designs and nearly all new patterns, it is a most appropriate time to incorporate in these designs all the practical improvements which experience and good judgment approve.

Mr. Fish thinks that much can be done in the design of a lathe to prevent the vibration or "chattering" of the work and this is true to some extent, but my experience is that the proper fitting of all the bearing surfaces and joints does far more to prevent chattering than anything else. The superiority of the tools from some of the oldest and best known toolmakers is due almost wholly to their accurate fitting, as in many cases their tools are no heavier or better designed than those of other makers.

SOLID SPINDLE BEARINGS.

Any lathe made heavy enough for high-speed steel is not fit to be run at a suitable speed for small work or polishing and therefore need not be run at such high spindle speeds that the bearings will heat, which is the only practical objection there has been to making the bearings solid or without adjustment. If the makers of milling and similar machines can get good fits on solid taper bearings, which they do, the lathe maker can do the same, and ought to do so, as the duty on milling-machine spindles is as heavy as on lathes of similar size.

WEAR OF LATHE-SPINDLE BEARING.

If an adjustable bearing is considered necessary, then I think the one shown by Mr. Fish is better than the usual sort, as it comes nearer to being a solid bearing, and the adjustment is just where it should be. It should have the cap span, as suggested by Art Isan, though I am puzzled to know how Art Isan got the idea that the front bearing of a lathe wears upward instead of downward. In a shop experience of thirty years I have never found one worn that way. I have refitted the spindles on several lathes and tested many others and I have always found the spindle centers low and usually worn back some, so that they bored tapering holes, largest at the outer end. It is quite possible that a modern lathe taking heavy cuts with high-speed steel will wear the upper half of the box the most, but on a lathe doing general work the wear due to the weight of spindle and of the work carried is always more than that due to the reaction of the cutting pressure.

The cross-feed screw illustrated by Art Isan shows a defect common to nearly all lathes I have seen, and that is the very narrow bearing at the end of the sleeve against the hub on the handle. In all old lathes I have had apart to repair, I have found this narrow bearing cut into deep ridges. Considerable wear comes on this bearing from cross-feeding outward, and there is no good reason why it should not have ample bearing surface. With this improvement to the plan of having the screw in tension both ways, as shown by Art Isan, it would be much superior to the usual thing.

EQUAL LENGTH BEARING SURFACES.

I have adopted the plan of using equal length bearing surfaces wherever practical ever since Professor Sweet first advocated it in the AMERICAN MACHINIST, and I am surprised that Mr. Fish did not adopt it in his design of cross-slide, familiar as he seems to be with the work of Professor Sweet.

THE LIPE TOOL-POST.

I wish particularly to commend what Professor Sweet says about the Lipe tool-post, for it is the most convenient and secure tool-holder that I have ever seen. It is, however, not adapted to be used on the

compound rest of a small lathe, as it requires greater depth of socket for the tool-holder than is available on the swivel slide-rest. One firm I know of overcomes this difficulty by having an entire new cross-slide-rest made for some of their lathes of about the same swing, making them for the Lipe tool-post, and making a swivel slide with a base on it to fit in the same socket the Lipe post goes in. The swivel slide has the usual tool-post, and, as it is not used frequently nor for heavy turning, such a tool-post is not seriously objectionable, and when the swivel rest is removed and the Lipe holder put on, then the swivel slide joint is done away with. On all lathes of not too much difference in size they use the same size Lipe holder, and one swivel slide-rest does for more than one lathe, as it is easy to arrange the jobs so that no two of them will need to have it at the same time.

SELF-OILING BEARINGS.

I have seen so much good machinery ruined by lack of oil on the bearing surfaces that I have become a crank on lubrication. One thing I always admire on the modern belt-driven dynamo, and that is the practical, sensible, economical and in every way satisfactory self-oiling bearings they usually have. Then I meditate and wonder why so many bearings that are in use that would be just as much benefited by self-oiling devices are still oiled in the old wasteful, wicked and ruinous way. This brings up the subject of oiling lathe spindles, and if a solid taper bearing is adopted and made self-oiling in a practical and effective way which does not introduce weakness in the design, it will be so far superior to the split-box adjustment, squirt-can oiling style that the question of adjustment will not worry anybody and will be almost forgotten.

BELL CRANK.

Faulty Machine-Tool Design—A Device That Failed.

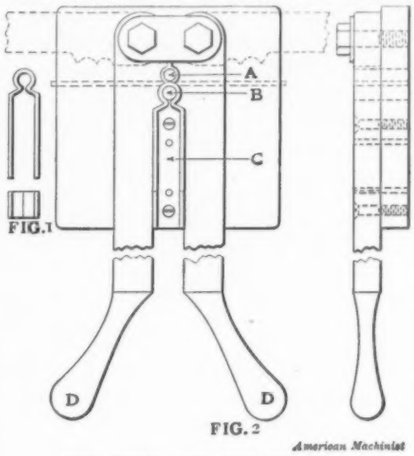
I notice that in Mr. Beach's criticism at page 740, he complains of the difficulty of starting the chuck true on the spindle nose, owing to the recess being bored too large. If he will cut off the first thread square on both spindle and chuck he will have no further difficulty. This will also greatly lessen the chance of the threads binding, owing to the presence of dirt, etc.

Referring to Mr. Judd's criticism of "A device that was a failure," it seems to me that the slipping of the dog was only one defect out of several. The lack of stiffness, caused by the spring of the long arbor was a more serious defect, and one which would effectually condemn the device, by rendering anything like a heavy cut impossible. It is a common characteristic of many designers of labor-saving (?) devices that they overlook this very necessary point. They don't realize that a minute or two extra spent in securely clamping a job will frequently pay for itself many times over in the time spent in actual machinery. The device in question is a case in point.

JOHN P. WHEELER.

Another Hand-Bending Fixture.

The description of two hand-bending fixtures, at page 564, reminds me of a similar tool that is quite simple, but also very satisfactory for some classes of work. This tool is shown at Fig. 2. The stock is



THE WORK AND THE FIXTURE.

1-16 by ½ inch, cold rolled, cut in 4-inch lengths. The form in which it is bent is shown at Fig. 1.

The fixture consists of a flat plate, to which are fastened two hand levers *D*, by means of cap-screws passing through a link, as shown. *A* and *B* are steel pins, and *C* is the forming block. The stock, shown by dotted lines in Fig. 2, is held in position for bending by the pins *A* and *B*. The levers are formed so as to bend the stock around the pin *B* and the block *C*. The open position of the levers is also shown in Fig. 2 by dotted lines.

When in use, the fixture is held in a vise. O. L. LEWIS.

Hardening a Small Die.

Having a small die for blanking hexagon nuts crack at three of the corners so as to be worthless, though it was reinforced by machine steel, I took the following means on the next one I made for hardening the center and leaving the outside soft: Taking brass, 16 gage telescoping tubing, of which we had suitable sizes on hand, I enclosed the die in three thicknesses, leaving the ends open. After hardening in the usual way, I found the result to be better than expected, the hardened portion being about one-third from edge of hole to outside of die and very uniform all around. The brass of course kept the outer portion from cooling quick enough to harden. Circumstances necessarily made this die of small diameter—1¼ inches, with a hexagon opening of ½ inch across corners. It has done lots of work in iron and is still good for more.

H. E. S.

"Things That are Usually Wrong."

It would be very difficult indeed should we consider all cases which need a remedy, but we should at least give the most important proper attention. The well-informed mechanic at once knows whether or not he will be able to make any practical use of an article he may have read, and, if he has an active brain, he will not only retain the idea, but will probably enlarge on it, and apply it to useful purpose.

For instance: an observant boy of fifteen years saw a peculiar mechanical movement on an old Howe sewing machine; sixteen years later, as a mechanic, he put the idea, somewhat modified, into use. This man was making things work himself; if he had consulted all the movements known to Hiscox, he could not have found means of doing this difficult job any better than it was done.

Things that are usually wrong are the result of design which could be improved; as no man is perfect, neither, perhaps, are mechanics, but they can become wonderfully expert by study and the practical application of knowledge thus gained.

There seem to be good reasons to believe that the American mechanic, although always noted for his skill formerly, is fast becoming more skilled; this, of course, is only the natural course of progress. Still, we have entirely too large a number whose ability is far below par with the average workman.

From a thousand mechanics selected at random from a large plant where more than three times that number are employed, the following has been taken: Fourth class, 55; third class, 140; second class, 310; first class, 475; special or expert, 20. From this number of men about 50 per cent., although some of them excellent workmen, had no decided ideas about mechanical problems in general, and in order to get good work from these men, care had to be taken to see that they had proper instructions, tools, gages and drawings for the work, or they would in a great many cases, if left to their own devices, go wrong. The other 50 per cent. were men who would study carefully the best way to handle a job, and use precautions to avoid mistakes. They had decided ideas as to how work should be done, and quite a number of them were inventors; one had had thirty-six patents granted him, several for articles which brought substantial returns, and one sold a patent for $15,000.

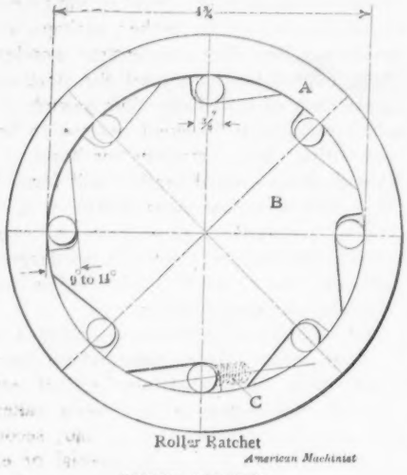
While we have good workmen, we need more; too many are deficient in their mechanical knowledge. The average standard of ability is too low; considering that the inventor and designer gets a great deal of his help from the shop, the sooner each workman qualifies for a higher standard, so much the better for the craft. Then, indeed, will everyone concerned be taking a hand in righting "things that are usually wrong"; and things of the class

which Professor Sweet points out have taken twenty years to remedy, we may hope to correct in much less time.

In bringing about the desired results, the workman in the shop will probably render the most assistance, and he should understand that by being better posted he will work a material good for all concerned. U. B. S.

Ball or Roller Ratchets.

Replying to G. C. H., whose request for information appears at page 706, I would say that perfect acting roller ratchets can be made as shown by the accompanying sketch. The included angle of contact between shell *A* and roller path of disk *B* should be not less than 9 degrees nor more than 14 degrees. Each roller should be held in contact by a light elastic spring *C*, which ensures quick acting in any position.



ROLLER RATCHET.

Balls are very much inferior to rollers, something I have proven by experiments, to my own satisfaction, or sorrow. In a ratchet for heavy duties, balls will break and crumble, and can be as easily halved as you would divide an apple with a knife.

The ratchet built as shown can be run up to about 800 to 1,000 reciprocations, and never miss. If possible, all working parts should be hardened, *i. e.*, the disk, roller, and the shell or cup. U. B. S.

Press Tools for Small Armature Disks.

At page 464, Jos. H. Blair describes a die for punching a small armature disk, in which he makes three operations. I made a die two years ago for a similar punching, 1-64 inch larger or 1¼ inches diameter, and with the same kind of slot. The die was made compound, punching a complete disk at each stroke of the press. In punching disks in one operation they will all be alike, and your finished armature will require no filing or milling to make the slots line up. The punch and die are both hardened, have punched over 200,000 disks, and the die is still in good shape. P. J. McConomy.

Some Gear-Cutting Experience.

I was pleased to read G. Ear's Gear Cutting Experiences at page 565, and have been tempted by his article to state a few of my own experiences along this line.

After a lot of experimenting, I have found that it is cheaper in the long run to cut a gear of coarse pitch (say up to 6 pitch) at two operations. Our method is to rough out a gear with an old cutter, using a 7-pitch cutter for a 6-pitch gear, and so on. This enables us to use up all our old cutters which may have the shape of the teeth altered through grinding. It is very evident that as the cutters are sharpened, the teeth must get a little smaller in size, due to the clearance on each side. Then we finish the gear with a cutter which is correct as to size and shape. We find that it is advantageous to run at coarse feeds for roughing, and fine feeds for finishing. At the time of writing, we are cutting some 80T-5P gears on a new Brown & Sharpe Gear Cutter. The material is gray iron and the cutters are 3½ inches diameter with 8 teeth. The cutter arbor runs at 60 revolutions per minute, which is equal to 55 feet per minute cutting speed with a 3½-inch cutter. For roughing, the feed is 8 inches per minute, and for finishing, 4 inches per minute. The gears in question are each 2-inch face, and we have three on the spindle at one time. It takes one hour to rough out the three gears, and two hours for finishing, making a total time of three hours, or one hour per gear. The roughing cutters are sharpened after every two sets of gears, or every two hours, and the finishing cutters after every four sets of gears, or every eight hours. We always keep both a roughing and a finishing cutter ready sharpened to put on directly the old one is taken off, so that the machine does not have to stand while the cutter is being ground. When we have gears going through in big quantities, we generally have one machine set up for roughing and one for finishing. In roughing out large pitches we found that the cutter was apt to get rather warm, so a small blower was fixed near the machines and arranged to be driven at a very high speed from the countershaft, a main supply pipe about two inches diameter was run along the back of the machines, and each machine had a small rubber pipe coupled up to the main pipe, and fixed to the sliding head. A reducing nozzle was fitted in the end of this piping, so that the blast of air could be directed on to the cutter, thus keeping it fairly cool. We have also fitted a small wire brush to the slide to rub against the cutter as it is revolving. This loosens all the bits of iron which may have stuck to the teeth.

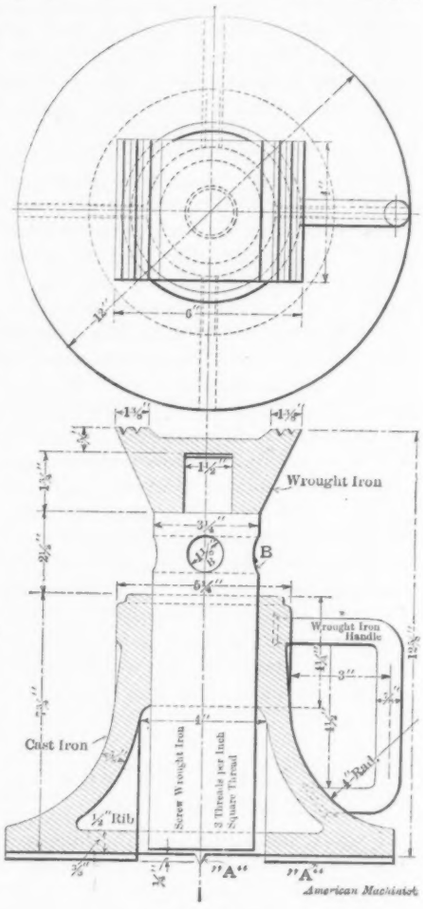
One point to watch when sharpening the cutters is to see that a sharp-cornered emery wheel is not used. If it is, as the teeth are ground down the front, it leaves a sharp corner at the bottom of the tooth and this is liable to start a fracture when the cutter is at work.

When cutting steel gears, we run the cutters from 80 to 100 revolutions per minute, according to their size, but we never feed more than 4 inches per minute, and when the pitch is small we have to use a feed much finer. As yet we have not reached the limit we can cut brass gears at; 10 inches per minute is about our usual feed. Gear Cutter.

B——, England.

A Jack-Screw.

The accompanying sketch shows a home-made jack-screw. The main casting is of gray iron, with a 12-inch circular base, 5¼ inches diameter at the top and 7¾ inches high. For a handle take a ⅞-inch piece of round iron, bend it to the sizes given and peen the ends over as shown, thus making a tight job when the handle is cast into the base. At first we made the bottom of the base casting flat, but found that when lifting a heavy load the whole jack would turn, so we fixed the pattern over, making the four V-shaped lugs *A*, which manage to hold the jack on almost any kind of flooring. The screw is of wrought iron, threaded from the turning bar holes *B* to the end, with three square threads per inch. This gives the jack a lift of about five inches. The top is made of wrought iron and is grooved on top to



A JACK-SCREW.

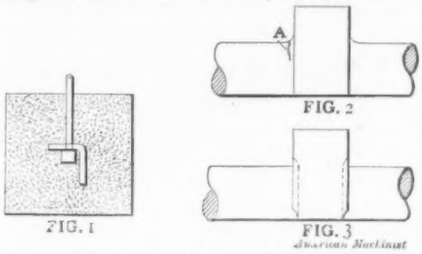
form a good gripping surface. The top revolves on a 1½-inch pin, which is formed by turning down the end of the main screw.

BAYARD.

California.

Angle-Iron Anchor Washer—Fillet on an Eccentric.

It may be common in some localities, but it was new to me when I saw a piece of angle iron used as a foundation bolt anchor



ANGLE-IRON ANCHOR WASHER—FILLET ON AN ECCENTRIC.

washer. The sketch, Fig. 1, shows the arrangement. The bolt head or nut, whichever is used, cannot turn; the pressure is as well distributed as it can be, and it is certainly easier to make where no pattern is at hand.

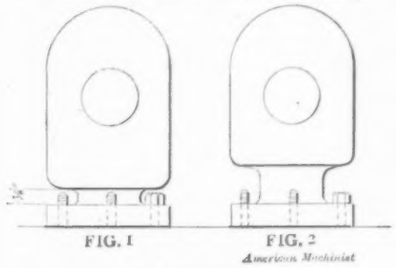
We have recently had a rather interesting break in the main shaft of a large gang punch press. Fig. 2 shows a section of the shaft, and the crack which developed is indicated at *A*. This crack was probably due to an imperfect forging.

And now the draftsman's error and the machinist's thoughtlessness come in. In replacing this shaft the drawing showed no fillet at the point where the break had occurred, and the machinist worked up the shaft according to drawing and asked no questions. The damage was, I believe, practically overcome by making the change indicated in Fig. 3; that is, the eccentric was undercut in order to obtain a fillet, thus distributing the strains at this pont.

MASON.

The Relief Valves on the Cruiser.

Some years ago I was fitting up the engines on one of Uncle Sam's cruisers. The work came down from the shops in



RELIEF VALVES.

scandalous condition; shafts were too long, shafts were too short, flanges on the main crankshaft were out of square, *and had to be filed square* on board. Whether these botches were due to errors in the shop or in design I do not know, but of all the annoying jobs I had, the putting on of the relief valves was the worst. These relief valves were on the tops of the cylinders immediately under the heavy armor grating, so that one had to work all hunched up. Fig. 1 shows their shape approximately. The studs were ¾ inch, and the distance from the flange to the dome was not more than ⅞ inch. The gaskets were first put on, then three thin pieces of wood were laid on the gasket, spaced about 120 degrees apart. On top of these thin pieces three wooden wedges were placed, tapering from ¾ inch down; the thin wood underneath protecting the gasket from abrasion as the wedges were drawn. The relief valves, weighing about 100 pounds, were then lifted into place on the wedges.

The nuts were then placed around the flange over the stud holes and the wedges gradually drawn till the tips of the bolts lifted the nuts, which were then turned with the fingers. If the wedges were drawn unevenly or a little too far or not far enough, the nuts would jam. After the nuts were all screwed down about ¼ inch, the helper carried up the weight of the valve, the wedges and pieces of thin wood were removed, and the underneath part of the dome rested on the nuts. The nuts then were tediously turned one cant—all round—at a time till the flange rested on the gasket.

There was no reason why the valves should not have been made as at Fig. 2, without increasing their total height.

I hope that in the future state, the draftsman who designed those relief valves will have to take similar valves off and put them on again while hot.

DIXIE.

Reducing the Thickness of Long Keys.

With reference to the description at page 291, by "Texas," it was quite amusing to see the trouble he had with that cold-rolled stock; although he did not say it was such, anyone can readily guess what he was planing by his apparent surprise at the big bow he saw when releasing it after the cut was taken off.

By his statements one not any the wiser would be led to think that a vertical miller with an inserted-tooth cutter was the only place cold-rolled stock could be machined without kinking and curving it out of shape. It seems he lost sight of the fact that he took a cut off both sides before he got results on the miller, and that the stock curved up there also after the first side had a cut removed. Had he taken a cut off of both sides on the planer or horizontal miller, he no doubt would have had just as good or better results. I don't think the fact of running the cut crosswise of the stock had anything to do with getting a better job on the miller; it was all in the chucking of the job and removing the strains of the scale on the two sides.

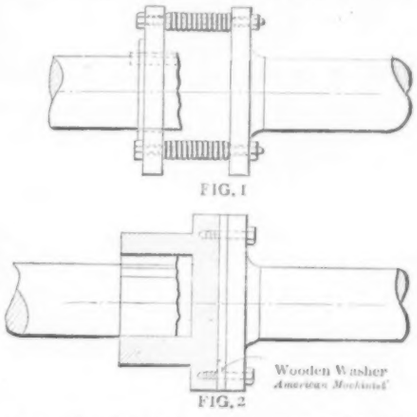
I have found that the scale or hard surface on flat or square cold-rolled stock varies in depth and sometimes nearly a thirty-second can be removed without releasing the strains, and then again I have found that to take that amount off the second side would cause it to bow up; this seems to show that the scale is deeper on one side than the other.

I may add that if cold-rolled stock is annealed first it can be machined and there will be no springing, as the strains are released by the heat applied.

CAMERON.

Repairing the Broken Shaft of a Centrifugal Pump.

A few years ago I was tending water on a coastwise tramp in the Southern lumber trade. I was in the Second's watch, and two bells had gone on the middle watch. We had just passed Diamond Shoal Lightship. Say, fellows, talk about calm! Not a breath stirring! The old fan engines were holding the draft to 2¼ inches, but the stoke-hole was terribly hot. All of a sudden the main engine began to slow



HOW THE BROKEN SHAFT WAS REPAIRED.

down. A glance at the gages showed that the vacuum was gone. The throttle was at once nearly closed; then the circulating pump, which was of the centrifugal type, confirmed our worst fears—the shaft was broken. A few sharp orders given, and less than three minutes from the slow-down the engine was going ahead under three-quarters speed, the fire and bilge pumps doing duty for circulating. After getting under way we examined the break. The pump shaft was of bronze, 2½ inches diameter, with a flange on the end which was a part of the shaft. The flanges of the engine and pump shaft were bolted together by five ¾-inch steel fitted bolts. The pump shaft was broken straight across close to the flange. The fibers were not bent, due to the twisting action of the shaft; but the shaft was a little out of line (although no trouble had ever been experienced from warm bearings), causing a slight bending motion at every stroke of the engine. The Old Man called it "fatigued metal." We took an old pipe flange and keyed it on to the

pump shaft and bolted it to the flange on the engine shaft with three ½-inch bolts, blocking the distance between flanges with washers. This makeshift ran 475 miles at slightly reduced speed of the pump; then permanent repairs were made by fitting a gray-iron flange to the pump shaft and bolting it up with wooden washers between the two flanges, making practically a flexible coupling of limited scope. I have a sketch here that the cadet made. Fig. 1 shows the temporary repair, and Fig. 2 the permanent repair. H.·A. S.

System.

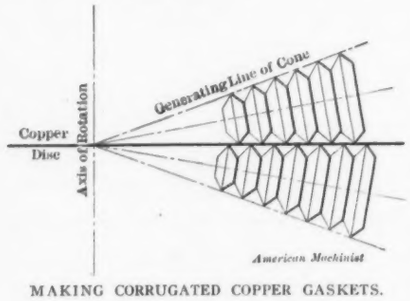
I find in the *Iron Mongers' Chronicle* this bit of verse, which I think is rather good, and hits well at anyone who might have a good system badly carried out.

Basinstoke, Eng. DAVID GARVIE.

Oh, isn't it great to be up-to-date,
And live in this year of grace;
With a system and place for everything,
And nobody knowing its place?
Why we have a card for each thing we do
And for everything under the sun,
But it takes so long to make out the cards
That we never get anything done.

Making Corrugated Copper Gaskets.

At page 679 I notice an article by Dixie on the corrugating of sheet-copper gaskets. Permit me to lay before you my impressions on the subject:



MAKING CORRUGATED COPPER GASKETS.

First—I think that it is necessary to have the generating lines of the cones, in the machine described by Dixie, and also the axis to converge at the same point as the axis of rotation of the copper disk, in order to avoid unnecessary slipping. This feature will limit the range of the machine, and only a limited number of sizes of disks can be corrugated this way, unless a set of cones of different lengths can be adapted for different diameters; also the zone to be corrugated is limited to the length of the cones.

Second—By this method of corrugating the disks are subject to a gradual circular expansion, due to the pressing which will cause them to buckle and not lie in a perfect plane.

Therefore I think that, having to build a special machine to produce gaskets in large quantities, the problem can be solved more economically by the use of power presses. This will require also a line of standard sizes of dies, but will also insure a much neater job.

The copper disks used in the manufacture of such gaskets not being of great thickness, it will be easy to see that a powerful press is not required. Two presses can answer the purpose, one doing the punching or cutting to sizes, and another doing the corrugating. This method is also much quicker than the one described by Mr. Dixie.

T. BARRAJA-FRAUENFELDER.

A Fish-Line Belt; a Successful Substitute.

On reading A. J. Spitz's suggestion at page 671 about the fish-line belt, I recollect having had similar trouble, only that I used catgut. It was on small lathes, used for turning sapphire jewel bearings for scientific instruments. After experimenting with different belts, I tried some good belt lacing, cut in nice strips 5-32 inch wide, turned a groove in the wheels 3-16 inch wide and slightly concave at the bottom, and joined the two ends of the belt by means of a soft brass wire hook so that the two ends of the belt closed, but before joining I duly stretched the belt. They stood up well under the strain that was put on them when starting to turn a piece of rough stone. One of these belts lasted three weeks or more. The diameter of the small wheel was 1¼ inches and the large wheel was 10 inches in diamter and made from aluminum. J. F.

A. S. M. E. Discussion on Bearings.

With reference to the portion of the discussion on bearings, by Oberlin Smith, as given at page 821, the following corrections and remarks should be noted:

In the account given of the automobile incident the impression is given that the prices refer to the whole bearing, whereas the shell alone is meant. In the following paragraph the length of the bearings of the toggle press should read 14 inches instead of 40 inches. The load should read 20,000 pounds instead of 30,000 pounds. The next sentence is so abbreviated that the idea is not quite clear; what was intended to be expressed was that the valve-like joints were difficult to oil, and to keep oiled, on account of the perfect fit of the joint, and because there was no intermittent opening and shutting between the surfaces to allow the oil to work in, as would be the case with upper toggles, where the weight of the ram would pull them open and the pressure upon the work would close them, the inference being that this heavy load of 20,000 pounds per square inch was borne in spite of the somewhat difficult lubrication.

In the paragraph at the top of the second column, referring to a fly-wheel running freely, and perhaps somewhat loosely, on a stationary shaft or stud, the words "wider" and "narrower" should be interchanged, the idea being that with a revolving shaft, running in a stationary bearing, the tendency was to keep a complete half-circle of contact, which, of course, would give much more projected area than could be the case with a wheel on a stud. Mr. Smith stated that the pressures on the bearings of power presses are run all the way from 1,000 to 20,000 pounds per square inch, which seems astonishingly great when compared with the ordinary standards for machinery in general.

A Modern Method of Taking an Inventory.

BY F. B. JOHNSON.

No up-to-date concern, not even a country grocery or hardware store with pretensions of modern organization, omits the taking of a general or complete inventory at stated intervals, but few concerns take their inventories in the most rapid, accurate and economical way, and fewer still get out of the pages of their inventories all the valuable information that they contain.

For the most part people are content if, with the aid of their inventory totals, reached after much labor, they can by the middle of February draw up a statement of assets and liabilities which is sufficiently comprehensive and detailed to show in a general way the results of their past year's business. If the business shows a profit

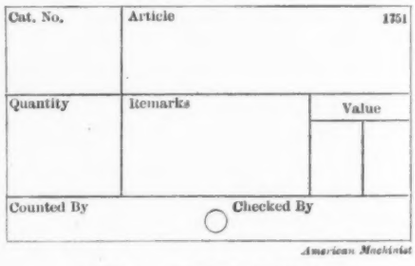


FIG. I. INVENTORY CARD.

of reasonable size, not unexpectedly small or large, they are satisfied; the costly inventory has, in their opinion, served its purpose.

The man who is satisfied with this casual and wasteful treatment of so costly a thing as an inventory may be fairly accused of lack of knowledge of his business, and is surely in need of some sort of rude awakening, a thing he is very likely to get if he has any competitors who are worthy the name.

To get the most value out of a real inventory, made up by the counting, weighing, measuring, listing and valuation of material, fixtures, etc., one should have, for use in connection with it, a permanent or going inventory, showing the receipts and deliveries, *i. e.*, the total consumption of each item since the last actual inventory.

With these two things at hand and in proper shape many valuable deductions may be made, and the conduct of a busi-

ness may be very greatly simplified, and many items of waste cut down or entirely eliminated. A great part of the value of the conclusions alluded to is lost if they are not quickly reached, and this has led some of the best managed concerns the writer knows to adopt a method or system of making an inventory, which admits of getting totals more promptly and accurately than has been possible under old methods.

This improvement in the system of taking the inventory has also resulted in a reduction and simplification of the labor of tabulation, which is always incident to making an inventory, and has made it possible to arrange the items of which the inventory consists in a natural or logical order, so that reference to any item in it is natural and easy, and almost instantaneous. Added to this it is possible to establish an accurate check of the accuracy of each item, to localize the responsibility for any errors found, a thing which will insure careful work in the first place, and in the ultimate result insure almost perfect accuracy in items and total.

All these very desirable results have been attained by the adaptation of the card system to the taking of an inventory. The method of procedure is as follows:

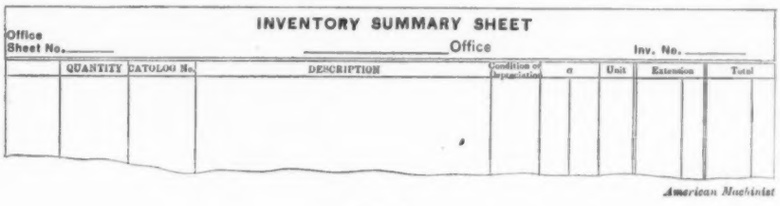


FIG. 2.

The ground to be covered must be gone over carefully in advance, and divided into sections in such a way that no two shall cross or conflict. A responsible person must be placed in charge of each section and should be given as many assistants as he can use to advantage, *i. e.*, without confusion or crowding. Provide beforehand slips or cards of a suitable standard size, printed in a form convenient for the purpose and numbered consecutively.

These slips or cards need be only large enough to record one item on each, *i. e.*, the quantity of goods of one kind, size, quality, etc., which are found together in one place and may be counted, weighed or measured together. The form shown in Fig. 1 is 3x5 inches, and has been used successfully for a number of years.

For convenience in use these slips or cards should be padded in blocks or pads of uniform size, with fifty or one hundred numbers to each pad.

These pads should be distributed to the men in charge of the various sections, sufficient of them to each to provide for his section, and each man in charge of a section (section superintendent we may call him for convenience) should be held to account for all cards given him; in other words, each section superintendent must hand in his full quota of cards, either written or blank, and whether he does or not is quickly determined by sorting the cards by number and checking through. This should be done as soon as the counting, etc., is completed, and if it is found that any card is missing it should be looked up at once. The man responsible for the card in question will remember (or a memorandum of it may be kept) about where each pad of cards was used, and any card overlooked is almost sure to be found.

Each person who does actual counting, weighing and measuring, should be assigned to a definitely marked shelf, bin or floor space, and should be provided with a pad of cards; he should begin his work at one limit of his space, and should work through his entire space in logical order till he reaches the end of it. He should write a separate card for each separate lot of each size, kind, grade, quality, brand, etc., he finds, and if it is possible to do so he should leave each card with the lot of material it represents.

As each man finishes his alloted space he should be given another, or if all are assigned he should be set to check the work of someone else, and so on till a check of the entire inventory is provided for. As the checkers work they should call the attention of the section superintendent to any errors, omissions or duplications found and all errors should be corrected on the spot. Neither counters nor checkers should figure values as they work, but where any lot of material is found which is second-hand or shop-worn a note should be made of its condition. That the work may interfere as little as possible with the routine of business, it should be taken on some holiday if possible, and enough men should be used to insure its being completed in the least possible time.

After all the cards have been accounted for they may be used in a great variety of ways.

If the total value of the inventory is wanted in a hurry the cards may be distributed, without any preliminary sorting, to all the clerks available for pricing and extension, and after the prices and extensions have been checked the total may be quickly reached by using an adding machine. Department totals may be obtained very quickly, in fact at the same time, if the cards have been sorted by departments. As soon as the figures required for immediate use have been completed two different tabulations should be effected; *i. e.*, a tabulation by totals of each class and kind of material for the whole business, showing how much of each item is in each department, and a tabulation by departments to show what each department has of each class and kind of material. A comparison of these tabulated schedules with each other, and with previous schedules of the same kind and with a perpetual stock inventory or record of consumption cannot fail to be very instructive.

For convenience of comparison all tabulated schedules should be made in the same form and same sequence so far as possible, and furthermore all schedules should be written with the typewriter on loose sheets, so that as many copies as are necessary or desirable may be made at the same time. These sheets should be numbered and the first sheet of each schedule should show the numbers of the sheets contained in the schedule, so that the omission of any from any copy may be apparent. The form of sheet shown in Fig. 2, with slight changes to fit individual needs, is a good one.

It is not my present purpose to attempt to say what deductions may be drawn from such inventory schedules as are herein described; the conclusions to be reached will differ under different conditions and in different businesses.

This method or system provides the means to many desirable ends which any live merchant will see for himself and, while facilitating the speedy reaching of necessary totals, effects a great economy in the actual cost of taking and tabulating an inventory, whether in a large or small business, whether dealing with thousands of items or with only a few.

The managers of the Frankfort-on-Main division of the Prussian State Railways have made experiments during a period of several months with the Pfirmann-Wendorf apparatus for preventing accidents on railroads. This appears to be in its elements merely a "third rail" placed between the track rails and insulated from the ground, a contact device, and the apparatus on the locomotive, which includes a small storage battery. The track rails also form part of the circuit, as in electric traction systems. The apparatus is arranged to give a signal in the cab by means of a red light and by ringing a bell, if there is an obstruction within a certain distance. The locomotive is also provided with a telephone supported on springs to protect it from vibration, the auxiliary rail being employed for the telephone circuit also. Old track rails can be used as material for the auxiliary rail line to reduce its cost, and if desired it need only be laid in the vicinity of dangerous curves, sidings, bridges, tunnels, junctions, etc.

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The A. S. M. E. and the Railway Associations.

The editor of the *Railroad Gazette* can evidently find little or nothing to approve in the management of the American Society of Mechanical Engineers, and chiefly we gather, because it is not like the Railway Master Mechanics' Association. He says it was hoped that when the American Society of Mechanical Engineers met in Saratoga, it would learn something from the Master Mechanics' Association, which was meeting there at the same time, about how to run a meeting, but that hope was blasted, and the American Society of Mechanical Engineers now goes on, according to our contemporary, publishing a few papers which are of interest to nobody, doing nothing and settling nothing (because it does not indorse or adopt anything), and otherwise, generally amounting to nothing.

While we think that few of those best acquainted with the matter would for a moment claim that the American Society of Mechanical Engineers is organized perfection, yet it seems to be answering the purposes of most of its members fairly well. It is losing almost no members by resignation; it is growing rapidly by accession of new members, and the papers presented and discussed are, for the most part, quite interesting to a large share of the membership.

Upon reflection, our contemporary will perceive probably that the situation of mechanical engineers generally is quite different from that of master mechanics of railroads. Mechanical enginers, who are employed in the actual work of their profession, usually are doing work for individuals or boards of directors, who are not engineers, who appreciate nothing of the advantages or of the importance of publicity regarding methods of doing work, and who strenuously object to such publicity, either in the form of a paper presented before a technical society, or in any other way. And the railroad fares of members of the American Society of Mechanical Engineers are not paid by those who employ them, as is virtually done when the master mechanics are given free transportation to attend their meetings. These two facts, to say nothing of others that might be cited, make the problem of those who direct the American Society of Mechanical Engineers different from that of those who direct the Master Mechanics' Association.

As to the alleged fact that the precedents of the society prevent it from doing anything, that because it never has done anything or approved of anything, that is regarded as a sufficient reason why it never should or will, that seems to us decidedly nonsensical. We do not believe that any member of the American Society of Mechanical Engineers is deterred from serving upon special committees because he may know that the society will not formally indorse or adopt the report of the committee. The fact is that the society can always and usually does command the services of the best experts in the country, upon a given line of investigation to be carried on by a committee. The reports of such committees receive very careful attention and discussion by the membership at large, and when they are finally presented and placed upon the records of the society, after full and complete discussion, they may be as fairly said to represent the best results of the society's investigation of that subject as would be the case were the society to formally indorse or adopt them as being the only proper methods. The difference so far as the authority and influence of the report go is about equal to the difference between tweedledee and tweedledum, so far as we can perceive; nor can we see any reason why the effect of the course pursued upon the members of such committees, or upon those who might be asked to work upon such committees, could amount to anything more than that.

There are quite a number of men connected with railroads who belong to the American Society of Mechanical Engineers. We happen to know that these men have been asked to prepare papers to be presented before that society; some of them have done so, but by no means all of them. If they would do more of that, the criticisms which would be called out upon their papers would in many cases be broader, would be based upon a wider experience than is the case with the criticisms offered in the Master Mechanics' Association, and the discussions would in some respects be perhaps quite beneficial to those who prepared the papers, as well as to others.

As to the presence of the supply men's exhibits and the supply men themselves, which form so prominent a feature of the Master Mechanics' Association meetings, and which our contemporary seems to think is a feature that ought to be imitated by the American Society of Mechanical Engineers, we decidedly differ on that point. We do not believe that the meetings of a technical society should be made a sales bazaar, or that the supply men should be expected or allowed to defray the expenses of the entertainment of members and their guests.

While, as previously remarked, we do not imagine that the American Society of Mechanical Engineers is perfect, it is, we believe, much better than our contemporary, who naturally is interested in railroad work almost exclusively, seems to think it is. It will probably be better in the future, but we do not believe it will be better by reason of its imitating the methods or the characteristics of the Master Mechanics' and Master Car Builders' Associations, great and useful as those associations are in their way. There is more difficulty in obtaining interesting and valuable papers for presentation before

the society than there ought to be, but reasons for that are well understood by those who have taken the pains to look into the matter. They are reasons which for the most part do not apply, either to the railway associations or to the Institution of Civil Engineers for instance.

We publish (and pay for) a good many articles that would be offered to the American Society of Mechanical Engineers if they could be presented there without the identity of their authors being revealed; as they can be in our columns. We do not believe that railroad papers have anything like as much advantage of the Master Mechanics' Association for a similar reason. If our contemporary has suggestions to offer for the betterment of the American Society of Mechanical Engineers, such suggestions are sure to be welcomed, but to say that it should simply copy the methods of the railway associations is to give advice that cannot be followed, even supposing it were desirable to do so.

Machinists to Rank With Sailmakers in Our Navy.

Many of our readers will perhaps be surprised and gratified to know that Senator Hale has introduced into the Senate a bill which, if it passes, will actually make machinists, in this day and age of machinery, rank as high and have most of the privileges of boatswains, gunners, chief carpenters and sailmakers in our navy. If this bill passes—which is, of course, by no means certain—it will actually be true that machinists employed on vessels, which are a mass of machinery from one end to the other, will have a standing equal to that of sailmakers on the same vessels, which have no sails, and for years have had none. The bill will probably meet with the determined opposition of a good many naval officers, because carpenters and sailmakers in the days of Nelson and of Farragut were important functionaries, and many of our naval officers have not gotten over the idea that they still are, and probably believe that they are much more important than machinists, even at the present day. The bill is evidence that after all "de world do move," in spite of the doubt which at times exists on that point. The bill referred to, a copy of which has been sent us, reads as follows:

A bill providing for the promotion of warrant officers, providing that all officers of the navy shall be entitled to the pay of the grade to which promoted from the date on which they take rank therein, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, that the title warrant machinist is hereby changed to machinist; and machinists shall, after six years from date of warrant, be commissioned chief machinists, to rank with, but after, ensign, and shall, on promotion, have the same pay and allowances as are allowed chief boatswains, chief gunners, chief carpenters, and chief sailmakers: Provided, that no machinist shall be promoted until he shall have passed such examination before a board of officers as the Secretary of the Navy may prescribe.

Sec. 2. That no warrant officer, heretofore or hereafter promoted six years from date of warrant, shall suffer a reduction in pay which, but for such promotion, would have been received by him.

Sec. 3. That chief boatswains, chief gunners, and chief machinists shall be eligible for appointment to the grade of ensign, under the restrictions imposed by law upon the appointment of boatswains, gunners, and warrant machinists to that grade.

Sec. 4. That hereafter any officer of the navy who may be promoted or appointed to a higher grade under the provisions of existing law shall be entitled to the pay of that grade from the date he takes rank therein.

The Anthracite Miners' Convention.

The Shamokin convention of the anthracite miners has been the cause of some apprehension; but its outcome seems to be rather conservative. Few of the delegates appear to have been of the class which is anxious for trouble, and the proceedings indicate that the majority were quite willing to accept an amicable settlement. In fact, several proposals were made to bring about such a result; one of them being to re-convene the Anthracite Strike Commission, to act as an arbitration board. This, however, is a step which probably will not be taken.

Contrary to expectation, the convention adopted no formal statement of the miners' demands. The whole matter was put into the hands of President Mitchell and the Executive Committee; and their conditions will not be made public until they are submitted to the anthracite companies. It is practically certain, however, that the eight-hour day and the formal recognition of the United Mine Workers as a contracting party will be the chief points of their demands.

Concerning the first, we have already said that it is not a matter of great importance, under the existing conditions in the anthracite mines. Practically it does not affect the miners at all, and the reduction in time would apply only to the daymen, a less numerous and usually less considered class. That the main difference will come on the recognition of the Union, is altogether likely. Even this does not imply the impossibility of compromise. It will depend upon what is to be understood by recognition of the Union. If it is to mean the right of dictation by the Union as to how the companies are to conduct their business, the companies cannot and will not agree to any such surrender. If, on the other hand, it is to mean only the recognition of the Union to the extent of collective dealing as to wage rates and other fair conditions, a principle of which the equity is conceded in modern industrialism, an agreement may easily be arrived at.

The outlook now is not threatening. It is understood—we believe correctly—that Mr. Mitchell does not want a strike, and he can probably command the support of a majority of the miners. Much depends on the manner in which the negotiations are conducted. While there is no formal organization of the anthracite operators, there is really a more compact union among them than can be found anywhere else in this country—perhaps in the world. The anthracite companies can—and will—act as a unit. If they act wisely, we believe that there will be a peaceable settlement in the anthracite region.—*The Engineering and Mining Journal.*

The Associated Veterans of the Delamater Iron Works.

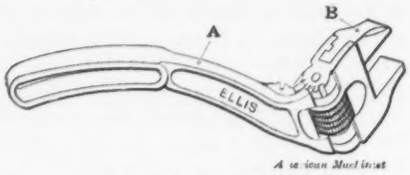
The annual meeting of this association was held at the Engineers' Club house of this city, December 19. The old board of officers was unanimously re-elected as follows: President, Alexander Miller; treasurer, W. M. Parker; secretary, James V. Ireland. At the conclusion of the election a handsome loving cup was presented to President Miller, much to his embarrassment and surprise. Luncheon was served and a pleasant evening of reminiscences was passed. The object of the association is to keep green the memories of early days in connection with pioneer work which has now become historic, of which the most noteworthy was the construction of the "Monitor." The association is in a flourishing condition and numbers twenty-seven members.

Edward Atkinson, of Boston, whose death was announced a short while ago, was widely known on account of his many activities in many different directions, but perhaps the most important work he did during his life was in the improvement of fire-insurance methods and means of preventing disastrous fires, which improvements were very largely due to him. He had the good judgment to perceive that the proper function of a fire-insurance company is to make a systematic study of means of lessening or avoiding fires, and of then insuring only such buildings whose owners had adopted these methods, and at a price based upon the cost of carrying the insurance. His mutual factory companies did this business on a very large scale, and undoubtedly have been instrumental in very largely reducing the cost of manufacturing operations, through the reduction brought about in the cost of carrying the fire risk, particularly in cotton mills, though of recent years the same methods have been largely adopted in other lines of industry.

New Tools and Machine Shop Appliances.

A COMBINATION WRENCH.

The illustration shows a combination wrench, in which the handle *A* is pivoted at the back of the jaw adjusting screw, so that it may be swung to any angle most convenient and locked in position.

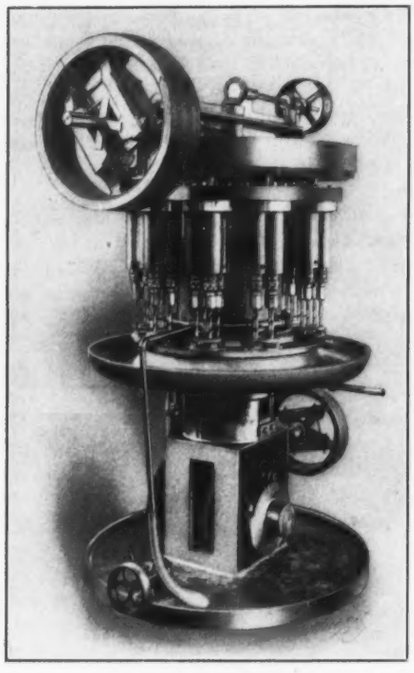


A COMBINATION WRENCH.

A serrated jaw may be substituted for the jaw *B*, thus converting it into a pipe wrench. It is made in five sizes, from 6 to 18 inches inclusive, by Patterson, Gottfried & Hunter, Ltd., New York.

MULTIPLE-SPINDLE DRILL.

The multiple-spindle drill shown herewith, designed for manufacturers, has thirty-six spindles, arranged in groups of four in a circle. The work is carried in jigs on a ring which revolves around the column. This ring is indexed automatically, and the operator takes out a finished piece and replaces the same while the drills are working. There are ten jigs on the work-carrying ring, and the head of the machine is spaced for ten drill-carrying heads; but one is left out,



MULTIPLE SPINDLE DRILL.

so that there is always a jig in front of the operator which is not in line with any drill head. The spindles are vertically adjustable to allow for different lengths of drills, and the table is vertically adjustable in addition to the feed mechanism. The machine is provided with a rotary oil pump and tank for lubricant, and is entirely automatic, except placing and removing work.

On the job for which the machine shown is set, there are thirty-six operations, so that when a piece is put in, it is completed after it has been around the circle and taken out and replaced.

The machine, which can be provided with any number of heads, set in any arrangement desired for manufacturing purposes, is made by the Moline Tool Company, Moline, Ill.

16-INCH CRANK SHAPER.

The crank shaper shown in the accompanying illustrations has among other points of interest a new feature in the method of guiding the ram, by the use of V's, like those of a planer, the ram thus tending to wear itself continuously in alinement, while the advantages of increased rigidity and absence of side play also are gained. Owing to the elimination by the V's of the side-play tendency, the tool is properly guided when taking finishing cuts, and the heavy strain during roughing cuts is directly taken by the broad flat straps, the pressure being normal to these. This method of guiding the ram also avoids tendency to spread the frame or buckle the ram. The strains resulting from the cut, as will be seen by the line drawing, are localized between each strap and the V's, thus obviating wedging action or strain between the V's on one side and those on the other. When necessary, the wear in the V's may be conveniently taken up by adjusting the flat straps.

The length of stroke is changed by positive adjustment, and is exactly indicated by a stationary graduated index, by means of which the stroke is adjusted either before the machine is started or while running. The index will be understood from the line cut, where *A* is the bevel gear shaft which adjusts the stroke; B, a stationary, graduated arm secured to the column; *C*, a ring with a zero line around its periphery. The ring has a lug formed at one side, which lug is tapped out to form a nut and extends up through a slot in hub *D*, where it is engaged with the threaded portion of shaft *A*. When the latter is turned to adjust the stroke, ring *C* is fed along under the index, and, whether the machine is running or still, the continuous zero line on the ring is always visible, so that the desired length of stroke is easily obtained. The position of the ram may also be changed by screw

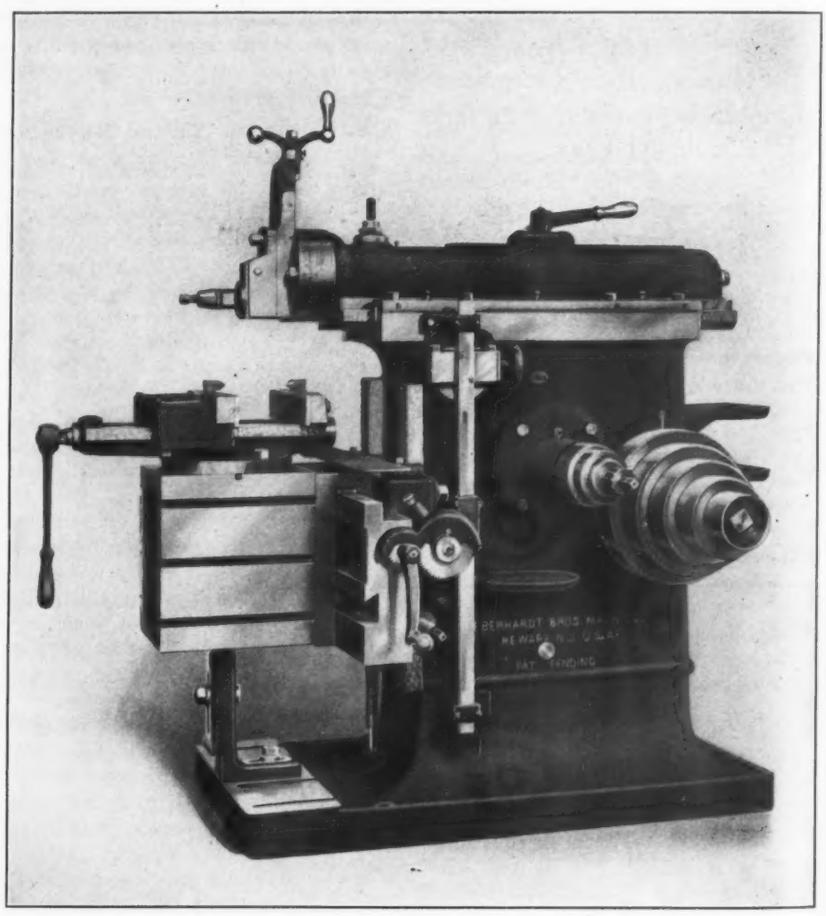


FIG. I. 16-INCH CRANK SHAPER.

adjustment, either while the machine is running or at rest.

The machine is made either with single or back gear. In the back-geared style, as shown, the double train of gearing is used, with a double bull wheel, to permit the cutting power and cutting speeds to be conveniently regulated to suit various grades of work and material, without high speeds of shafts and gears, on short strokes. The cone pulley runs upon its own bearing, instead of being mounted directly on the pinion shaft, thus relieving the latter of belt strain. The pinion shaft is driven by means of the squared outer end.

The box table is of the universal style, which may be swiveled in a complete circle, so that any side may be used as the working side, the box being rigidly held in any desired position. The vise is graduated, may be swiveled to any angle, and is so constructed that the jaws are drawn (not pushed) together. The method of holding the vise to the table is such that all adjustments are made from the top of the table. The traverse-feed mechanism is operated by means of the vertical reciprocating rod, and the feed is readily changed whether the machine is in operation or at rest. The feed stops automatically at each end of the traverse, and also automatically adjusts itself to any elevation of the cross-rail.

The shaper is provided with extension base and outer support for the table, the foot being reversible, so that the support may be used whether the table is elevated or in a very low position. Provision is made for taking shafts up to 2½ inches diameter under the ram for keyseating purposes. The actual length of stroke is 17½ inches; the cross-feed of table, 21¾ inches, and the vertical travel, 18 inches. The table top is 11x12 inches, and the sides 12x13 inches. The feed of the tool-block is 7 inches. The machine weighs 2,450 pounds, and is built by Eberhardt Brothers Machine Company, Newark, N. J.

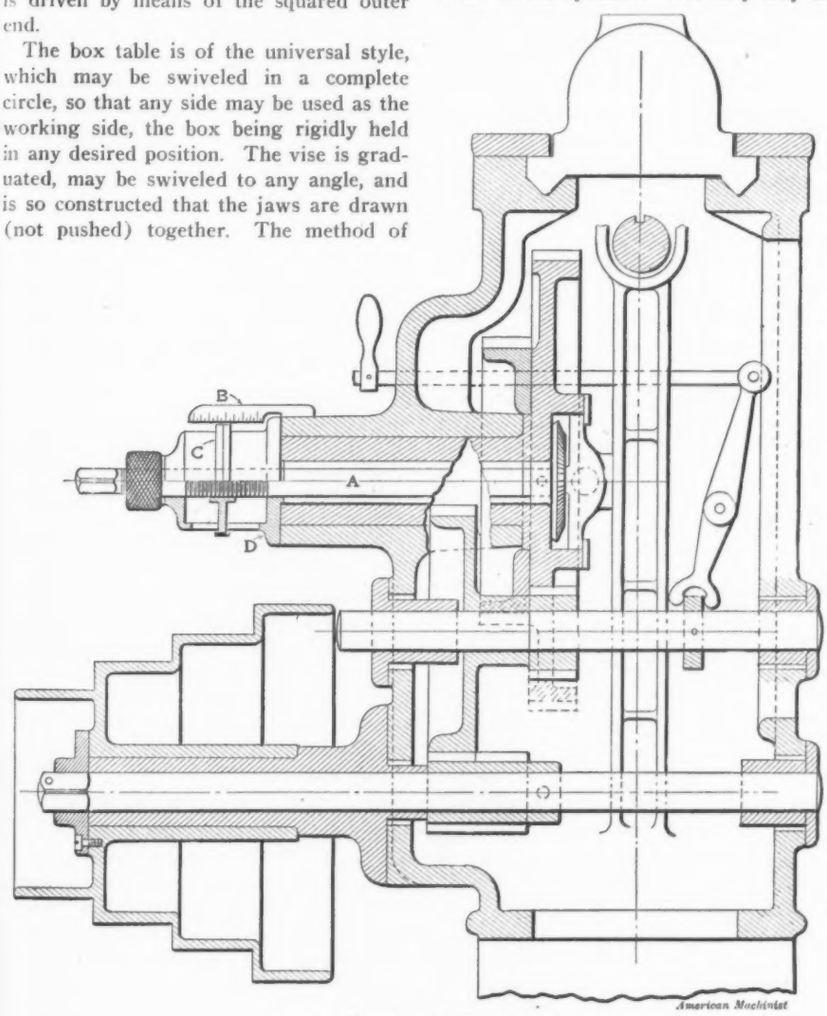
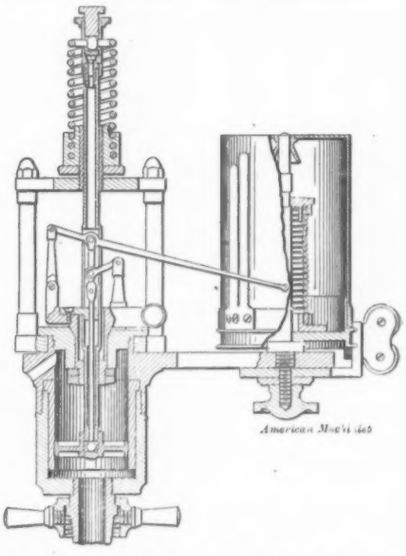


FIG. 2. 16-INCH CRANK SHAPER.

AN EXTERNAL SPRING INDICATOR.

The obviously correct location for the spring of steam-engine indicators is external to the cylinder. Not only may the spring be changed without danger of burning the fingers, but the protection of the spring from heat gives a uniform scale regardless of the temperature of the cylinder indicated. In tests of the two ends of pumps or air compressors, the location of the spring within the cylinder leads to a hot spring for one end, and a cold one for the other. Of course constants have been published for correcting the resulting error, but they are seldom used and the result has always been to cause us to place small faith in friction determinations based on such cards. Moreover, it is obviously better to eliminate an error than to correct for it.

The merits of the external spring were first recognized by indicator manufacturers in England, where several instruments with such springs are now made. We note with satisfaction that the movement has now reached this country, and we publish herewith an illustration of the new Crosby instrument having an external spring. The piston has been increased in area to 1 square inch, the object of this being, we judge, to offset the necessary increase in weight of the reciprocating parts. The piston forms the central zone of a sphere, and is connected by the hollow rod directly with the upper end of the spring, which is thus an extension and not, as with internal springs, a compression spring. The spherical form of the piston obviously prevents binding, due to eccentricity in the action of the spring. The position of the zero line may be adjusted on the paper by loosening the binding nut below the spring and then screwing the spring upward or downward as desired.



THE CROSBY EXTERNAL SPRING INDICATOR.

We predict that the time is not far distant when the internal spring indicator will become out of date.

A SPRING FOOT-PRESS.

The spring foot-press shown is designed to take the place of the ordinary foot-press and light drop hammer on work requiring a sharp, quick blow, as in riveting, forming, swaging, assembling, etc.

The essential difference between it and the ordinary foot-press is that in this machine the force of the blow is controlled by the tension on a spring, which may be varied to suit the work. After being once set to the proper tension, the blows are uniform, regardless of the care of the operator. It is much more rapid than the ordinary foot-press, easier on the operator, and no jar, caused by the stopping of the die, is communicated through the lever to the operator's foot. The force of the blow is controlled both by the ten-

sion on the spring and the stroke or drop of the slide, and can be made much more powerful than in a lever foot-press of the same weight.

The table of this machine stands 30 inches above the floor; the height from the bed to the extreme lift of the slide is

A SPRING FOOT PRESS.

5¼ inches, and distance from the center of the slide to the column is 2¾ inches. The machine requires a floor space of about 24x24 inches, and is particularly well adapted for electrical, jewelry and work of a similar character. The machine is furnished in this one size, either on legs, as shown in the illustration, or without table for use on the bench. It is built by the Phœnix Iron Works Corporation, of Hartford, Connecticut.

A TOOL BOX.

The illustrations show—two views, shut and open—a new departure in the way of a machinist's tool box. The outside is made of sheet steel oxidized-copper finish. It is provided with a handle on top. Brass-plated cast-steel ends form the feet and also a runway for the door which slides around them and is locked by a small hasp and padlock. The inside is fitted with a series of wooden drawers lined with velvet. It is fire proof, cleanly, has a free open space under it, is very light in proportion to its capacity, is 9 inches high by 16 inches long, compact and durable. This tool box is made by F. G. Marbach, Medina, Ohio.

New Publications.

"Machine Design." By Albert W. Smith and Guido H. Marx. 369 6x9-inch pages, with 278 illustrations. John Wiley & Sons, New York; Chapman & Hall, London. Price, $3.

This is one of the most satisfactory treatises on machine design that we have seen. It not only recognizes the inadequacy of mathematical analysis to determine the dimensions of many machine parts, but, to a far greater extent than is customary in such books, it discusses other features of design than the determination of the dimensions necessary to resist the applied forces. One feature which will appeal to many is the presentation of the outline of the Reuleaux system of kinematic analysis and its application to the finding of the velocity ratios of connected parts. The subject of outlines and their fitness to the strains to be carried also receives considerable attention. In so far as the book relates to steam-engine design, the constants used are those developed by Professor Barr's inquiry among steam-engine builders, and in other cases constants are based on the most recent investigations, making the book strictly modern. Professor Smith was formerly a student of Professor Sweet's, many of whose ideas will be found in the book, and some of the "things that are usually wrong" should be impossible to the student trained by its use.

"Reference Book for Statical Calculations." By Francis Ruff. 136 5x7¾-inch pages, with 160 illustrations. E. and F. N. Spon, Ltd., London; Spon & Chamberlain, New York.

This may be described as primarily a manual of, rather than a treatise on,

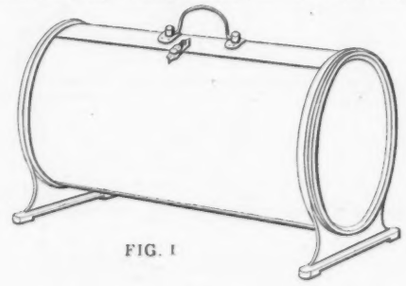


FIG. 1

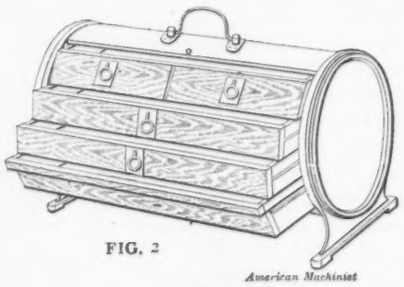


FIG. 2

American Machinist

A TOOL BOX.

graphic statics, as applied to structural work. All the common forms of trusses are given, with the diagrams from which the stresses on the various members may be determined, and on facing pages brief instructions for drawing the diagrams are given. These instructions are scarcely sufficient, and, we judge, are not intended to be sufficient, for use by those having no previous knowledge of graphic statics, but to the engineer possessing a knowledge of the principles of that science the book should be exceedingly useful. Instead of applying general principles to each case and working out his own diagram, he has only to turn to the proper page and find it. We have no doubt that the book will find large use among engineers and architects engaged in the design of structural iron work. Rather more than a quarter of it is given to tables of the properties of rolled sections, but, the book being a translation from the German, these tables are for the standard German sizes, the dimensions of which are expressed in metric units, as are also the weights, moments of inertia, etc.

"Guide de l'Ajusteur" [Fitter's Guide, containing Laying-out, Chipping, Measuring Instruments, Filing, Scraping, Polishing and Frosting, the different kinds of Fitting, Drilling, Reaming, Thread-cutting (by hand tools) and Tapping, Hammering (peening and riveting), Tables of Gages and of Screw Threads; for the use of Mechanicians, Students of Apprentice Schools, Industrial Schools, Technical Courses, of Journeymen, Foremen and Master Mechanics]. By Jules Merlot, Engineer-Mechanician, Assistant Professor in the Machine-Construction Course, and Chief of Shop-Work, in the Technical Faculty of the University of Liège. One volume, cloth, 343 pages 5x8¼ inches, containing 409 illustrations. Paris: Librairie Polytechnique, Ch. Béranger, Editeur, 15, Rue des Saint-Pères. 1905.

This book, printed in good type and neatly bound, should prove very useful to French-reading apprentices and mechanicians not thoroughly informed on the tools and methods of using them employed in manual operations in the machine shop. The sub-title gives a good general idea of the subjects treated in the work; the treatment is not exhaustive, but presents the elementary facts regarding the use of the tools, with the aid of clear zinc line engravings and wood-cuts, and a few half-tones, the latter being mostly illustrations of the different kinds of files. It includes six pages of tables of gages, and nine pages of tables of a variety of screw threads; the Whitworth and Sellers systems, which have the most space, have the dimensions given both in inches and in millimeters. In the body of the book are illustrations and descriptions of these various threads; it is noticeable that the sharp V-thread is not included. It would be well if practice in this country were such as to justify this omission in an American book. An alpha-

betical index is not provided, but the table of contents in the back, covering over four pages, is very complete.

The Young Men's Christian Association, of Detroit, announces the organization of courses of study in mechanical, architectural and free-hand drawing, sign writing and lettering, the steam engine, the gas engine, electricity, chemistry, plumbing and electrical wiring. Evening courses are also offered in mathematics, modern languages, shorthand, bookkeeping, etc.

The National Association of Cement Users' Convention will be transferred from Milwaukee, Wis., to Columbus, Ohio, owing to the burning of the Exposition Building at Milwaukee. As 10,000 square feet are required for the exhibits of the association, this fact made it difficult to secure adequate quarters. Columbus, Ohio, was finally selected. As the Governor's inaugural ball will be held on January 8, the dates of the convention have been advanced one day, thus making the convention dates as they now stand, from January 10 to 13, inclusive. It was not easy to secure adequate quarters, as the exhibits of machinery, cements, etc., at the convention will be unusually large.

Personal.

Robert T. Lozier has been appointed district sales manager of the gas machinery department of the Power & Mining Machinery Company, with headquarters at 52 William street, New York.

Harry C. Engfer, formerly superintendent of M. D. Knowlton & Co., of Rochester, N. Y., has become superintendent of the shops of the Cochrane-Bly Company, in the same city, builders of cold sawing machinery, filing machines, die engraving machines, etc.

Albert A. Clive, for many years connected with the Remington Arms Company, at Ilion, N. Y., and for the past two and a half years foreman of the barrel department, has resigned to take charge of a department for Sears, Roebuck & Co., at Meriden, Conn. The position made vacant by the departure of Mr. Clive has been filled by Frank W. Bach, of Ilion.

Obituary.

Joseph P. Barnes, vice-president and superintendent of the W. F. & John Barnes Company, Rockford, Ill., died in Rockford, December 10.

William H. Shock, Engineer-in-Chief, United States Navy, retired, died at his home in Washington, December 17, after a brief illness of the grip. Commodore Shock was a veteran of the Mexican and Civil wars and served under Commodore Perry and Admiral Farragut. He was born in Maryland eighty-four years ago and was therefore one of the oldest officers on the naval list. He was appointed Engineer-in-Chief of the Navy by President Grant and reappointed by Hayes.

Business Items.

The Curtis & Curtis Company, of Bridgeport, Conn., manufacturer of pipe cutting and threading machinery, has just opened a large store at 60 Centre street, New York city, where a full line of its pipe cutting and threading machines will be on exhibition. H. H. Walker will be in charge.

The Birdsboro Steel Foundry & Machine Company, Birdsboro, Pa., reports its being exceedingly busy. Among other orders recently secured is a contract to supply a large part of the machinery for the new 250-ton mixer which the Republic Iron & Steel Company is installing at Youngstown, O.

Boynton & Plummer, of Worcester, Mass., manufacturers of shapers, drilling machines, portable forges, bolt-cutting machinery, etc., owing to increased business, have been compelled to move from 52 Lagrange street, to larger quarters, and are now located at 54 Hermon street, Worcester. Their increased facilities will enable them to fill orders promptly.

The Standard Roller Bearing Company, of Philadelphia, has purchased, for about $100,000, the property of the Pennsylvania Iron Company, at Forty-ninth and Merion avenue, which adjoins its present property. The realty secured consists of a lot, 95 feet wide by 200 feet long, including a four-story brick building. This gives the Standard Roller Bearing Company 926 feet facing upon the Pennsylvania Railroad main line, near Fifty-second Street Station, making a total of over five acres, with several factory buildings having a total floor space of 145,000 square feet.

The Northern Engineering Works, of Detroit, Mich., have been awarded the contract for the electric cranes required in the new steel casting foundry of the Monarch Coupler Company, Ltd., of Detroit, Mich. There will be one 25-ton, four-motor electric ladle crane, 50-foot span; one 10-ton, four-motor standard crane, 50-foot span. This company has also recently completed installing three electric traveling cranes in the plant of the Detroit Steel Casting Company, consisting of one 30-ton, four-motor ladle crane, 70-foot span, and two 10-ton, three-motor electric cranes, 70-foot span, and are now constructing for the same firm a 10-ton, 80-foot electric gantry, for yard service.

The Simonds File Company, Fitchburg, Mass., has recently been incorporated under the laws of Massachusetts and taken over the plant and business of the Fitchburg File Works, maker of files, hack-saws, hack-saw frames, etc. The officers of the company are Daniel Simonds, president; Walter E. Culley, vice-president; Albert E. Culley, treasurer; John E. Kelley, secretary. These, with Gifford K. Simonds, Alvan T. Simonds and T. F. Howarth, constitute the board of directors. This company will be closely associated with the Simonds Manufacturing Company, the well-known maker of Simonds saws and machine knives, and by the use of the latter company's numerous branch offices and selling force it is planned to largely increase the business in files and hack-saw blades.

Manufacturers.

The Spicer Universal Joint Company, Plainfield, N. J., is enlarging its plant.

The Bay State Iron Works, Erie, Pa., contemplate moving to Conneautville, Pa.

Frank Russell & Co. will move their stave factory from Spring City, Tenn., to Harriman.

The New Jersey Aluminum Company, Newark, N. J., is building an addition to its foundry.

Rand, McNally & Co., of Chicago, Ill., will erect a $500,000 printing plant at Ossining, N. Y.

The Potter & Johnston Machine Company, Pawtucket, R. I., is erecting an addition to its plant.

The General Manufacturing Company, Philadelphia, Pa., oils and greases, will build a new boiler-house.

The National Cutlery Company, making razors, axes and hatchets, Detroit, Mich., will put up a new plant.

The Citizens' Gas & Electric Company, Council Bluffs, Iowa, will rebuild the gas plant, costing $60,000.

It is reported that the Baldwin Locomotive Works, of Philadelphia, Pa., may establish a branch in Des Moines, Ia.

The Harlan & Hollingsworth Corporation, Wilmington, Del., has awarded contract for the construction of its new car shops.

The Climax Specialty Company, maker of plumbers' supplies, Seneca Falls, N. Y., is erecting a new brass and iron foundry.

Contractors are figuring on the construction of an electrical power-house at Wilmington, Del., for the Philadelphia, Baltimore & Washington Railroad.

A new electric light plant, to cost $20,000, will be erected in New Florence, Pa. Alex. Wagner and other citizens of New Florence will finance the venture.

The Chicago, Milwaukee & St. Paul Railroad Company contemplates, it is said, the erection of a new machine shop and other buildings at Dubuque, Iowa.

The Central Foundry Company, of New York, has purchased a site in Vincennes, Ind., and, it is reported, will move one of its Birmingham, Ala., plants to that place.

The Standard Pulley Company and the Kisinger-Ison Company, a joint corporation, Cincinnati, O., have acquired some land, and plans are now being drawn for a new foundry and machine shop.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Cox Computers, 75 Broad st., New York.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

We make working drawings for others; why not for you? 627 Rose Bldg., Cleveland, O.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Wanted—Patented specialties of merit to manufacture and market. Power Specialty Co., 500 Washington ave., Detroit, Mich.

Make us your factory.
Specialties and machinery built to order. Close work; close prices. "Moderate," AM. M.

Work wanted for a Cleveland automatic lathe; handles 2 in. and under. The Earle Gear & Machine Co., 141 Oxford st., Philadelphia.

Wanted—A good second-hand 10-foot power squaring shear, heavy enough to cut ¼ in. mild steel. Write to American Bank Protection Co., Minneapolis, Minn.

Clock work and intricate mechanical instruments; meter counters, water, gas or electric; recording devices; special movements to order. D. S. Plumb, 57 E. Park st., Newark, N. J.

Wanted—One Brown & Sharpe second-hand automatic screw machine, No. 0; also one No. 2. Address, giving time they have been in use and character of work they have been making, also price, to George W. Dover Company, Providence, R. I.

The annual meeting of the stockholders of The Derry-Collard Co. for the election of officers, and for the transaction of such other business as may properly come before the meeting, will be held at the offices of the company, 256-257 Broadway, Manhattan, on Jan. 8, 1906, at 6 o'clock in the afternoon.

A. LEIGHTON DONNELL, Treas.

Tool Catalogue No. 22. 950 pages, bound in cloth. Greatest small-tool catalogue ever published. Will be sent post-paid on receipt of $1. Money paid for catalogue refunded with first purchase amounting to $10 or over. Book costs you nothing if you become a customer. Montgomery & Co., 109 Fulton st., New York City.

New York City, Dec. 15, 1905.

For Sale.

Second-hand lathes, 20 in. swing x 8 ft. bed; planer, 24 in. and 5 ft. bed. E. C. & A. E. Rowland, New Haven, Conn.

For Sale—10-ton crane, 40 ft. span, rope drive; has been tested to 20 tons; very low price for cash. Address Murray Iron Works Co., Burlington, Iowa.

For Sale—A bargain; 90 in. gap second-hand steam riveter, 36 in. cylinder; good as new; Wm. Sellers & Co. make; price $500. Box 923, AMERICAN MACHINIST.

For Sale—One No. 5 Rudolphi blanking press, all in first-class condition, having only been used one year; will sell at a bargain. Address Wilford Novelty Mfg. Co., St. Joseph, Mich.

For Sale—1,200-light electric plant, consisting of 100 H.-P. Payne engine and 60-kilowatt Edison dynamo; perfect condition; low price to quick purchaser. Apply to Estate of Henry C. Miner, 194 Bowery, New York.

Fine modern shop, approximately 60,000 square feet, equipped with up-to-date machinery, admirably adapted for the manufacture of automobiles and parts. Excellent location in thriving Indiana city of 20,000. Unexcelled shipping facilities. On two trunk lines. Labor first-class and moderate in price. No strikes. Capacity 200 men. Would make favorable terms. Send for full particulars. Box 937, AMERICAN MACHINIST.

For Sale or to Rent—Brass foundry, Bridgeport, Conn., opposite freight station and within 500 feet of water-front. Property consists of 113.4 square rods. Main building, 60x200 feet, and equipped with crucible (21) furnaces, trolleys, etc.; fire-proof pattern safe, coreroom and supply sheds, stamp-mill and well yielding 200 gallons per minute. Location also valuable as warehouse. Address R. H. W., P. O. Box 1358, New York.

Business Opportunities.

Wanted—Practical and thorough mechanic, as shop manager, who is willing to invest a few thousand dollars in an established machine-tool business in Cincinnati, O. "Z-25," care AMERICAN MACHINIST.

Gas engine designer, of extensive experience, has simple engine of extraordinary merits; would like to hear from capitalists or manufacturers who would be willing to go into business on large scale. Address "Four Cycle," care AMERICAN MACHINIST.

Sub-Let—Brick warehouse, Bridgeport, Conn.; two stories and high basement, with elevator; 75x150 feet, on lot 100x150 feet; directly opposite freight station, N. Y., N. H. & H. R. R. Present lease expires April, 1907. Address R. H. W., P. O. Box 1358, New York.

Owner of pattern-making business netting over $3,500 per annum retires in January. Foreman having charge of plant for the last 8 years will join with a competent man having $2,000 to invest and buy out present owner. Plant employs 18 men, has been running continually for the last 10 years, and can be obtained at a very moderate figure. Address "Foreman," care AMERICAN MACHINIST.

A mechanic, used to small die work or fine assembling, can purchase interest in a manufacturing business established 5 years and showing a good daily profit. Large and profitable orders on hand, sufficient to keep factory running for years. Company has machinery and materials worth $25,000, free and clear. Good opportunity for good mechanic with $5,000 to $10,000. Full investigation invited. Address Box 932, AMERICAN MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

MICHIGAN.

Superintendent wants position; American, age 39; educated, systematic, good mechanic and inventor; expert in brass foundry management; a hustler, and can deliver the goods. Box 938, AMERICAN MACHINIST.

NEW JERSEY.

Mechanical draftsman desires position; technical; has experience. Box 931, AM. M.

NEW YORK.

Position wanted as forge shop foreman; 15 years' experience in the business. Box 935, AMERICAN MACHINIST.

General foreman, responsible man, 36, experienced in high-grade duplicate general and mill machinery, expert machinist, wishes to make change. Pacific States preferred. Box 883, AMERICAN MACHINIST.

OHIO.

Wanted—By a practical diemaker, a position as foreman; thoroughly competent to design all kinds of dies for sheet metal work and light manufacturing; up to date in modern shop practice, and a hustler; Ohio preferred. Box 928, AMERICAN MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CONNECTICUT.

Wanted—Two floor and two planer hands on heavy work; steady work and good wages; no trouble; only first-class men wanted; state wages and experience. Farrel Foundry & Machine Co., Ansonia, Conn.

Wanted—A first-class engineer for stationary engine; one capable of handling engine and directing fireman; we operate about 400 H.-P. and use generator and electric current for about 125 H.-P.; want a thoroughly competent man. Address Box 922, AMER. MACH.

ILLINOIS.

Draftsman.—We have positions now open for draftsmen. Call or address Western Electric Co., Chicago, Ill.

Wanted—A toolmaker; must be acquainted with steam brass goods and their requirements; steady employment to a good man. Box 927, AMERICAN MACHINIST.

Salesman with mechanical education and experience in selling gasolene engine machinery especially; advise fully relative to experience, age, references and salary expected. Box 918, AMERICAN MACHINIST.

MASSACHUSETTS.

Wanted—Fellows gear shaper operators, also turret lathe men. Boston Gear Works, Boston, Mass.

Wanted—Man, between 26 and 34, with thorough mechanical experience, who has had charge of men; must be man of ideas and force. Box 87, Springfield, Mass.

Master mechanic, experienced and capable of supervising 1,000 H.-P. electric power and lighting plant, including repairs on same, millwrighting, plumbing, etc., in factory near Boston. Box 915, AMERICAN MACHINIST.

Machinists Wanted—We are increasing our force and need good all-around men for the building of special automatic machinery and jobbing. References as to character and ability required. Apply to L. F. Fales, Walpole, Mass.

MICHIGAN.

Wanted—General foreman to take active charge of iron and steel working plant; good opportunity for right man. Box 530, Lansing, Mich.

Wanted—3 or 4 first-class, A1 automatic screw machine hands; to experienced men will guarantee steady position and highest rate of wages. Answer, with reference, to Box 85, Detroit, Mich.

Wanted—Experienced machine operator for a new No. 1 Lucas horizontal boring, drilling and milling machine, in Detroit; state experience and wages. Address Box 892, AMERICAN MACHINIST.

MINNESOTA.

Wanted—Die and tool makers and bench hands, accustomed to small, accurate work; must be first class in every respect; highest wages. G. F. Kriesel, 2d st. and 5th ave., south, Minneapolis, Minn.

NEW JERSEY.

Wanted—A first-class mechanical draftsman; state experience and salary wanted. Box 881, AMERICAN MACHINIST.

We are increasing our tool-making department and solicit applications from toolmakers and machinists who are experienced on fine and complicated work. Apply to Victor Talking Machine Co., Camden, N. J.

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Lathe, planer and boring mill operators wanted for night shift; those accustomed to machine tool work preferred; steady work and good pay to good men. Address the Pond Machine Tool Co., Plainfield, N. J.

Wanted—Foreman; experienced man, to take charge of brass shop, manufacturing fittings, valves and plumbing specialties; give full particulars as to age, experience and salary last received. Box 897, AMER. MACH.

NEW YORK.

Draftsmen for jigs, fixtures, dies and shop tools. Apply to Mergenthaler Linotype Co., Brooklyn, N. Y.

Wanted—Experienced man on light drop forging; state wages desired and experience. Address Box 933, AMERICAN MACHINIST.

Wanted—Several first-class toolmakers on dies, jigs and special fixtures for small machine manufacture. Send references to Drawer No. 7, Syracuse, N. Y.

Machinists for floor work; must be first-class men who will appreciate steady employment; open shop; 9 hours per day; wages $2.50. Address Box 859, AMER. MACHINIST.

Wanted—By typewriter works, high-grade tool and die makers, for steady employment at good wages; in writing, state experience in full and pay desired. Box 934, AMER. MACH.

Wanted—Several A1 draftsmen; only those with 3 or more years' practical experience need apply. Engineer in Charge, Drafting Dept., General Electric Company, Schenectady, N. Y.

Wanted—Experienced draftsmen, first-class machinists, toolmakers, and gauge makers; give detailed experience, references, age and wages expected. Remington Arms Company, Ilion, N. Y.

Wanted—Two first-class toolmakers on combination dies and drawing dies for sheet copper, brass and sheet iron; advise as to experience, references and wages expected. Box 29, AMERICAN MACHINIST.

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Wanted—Foreman to take charge of about 20 vise hands in Cincinnati; must be well recommended, and had charge of vise work in tool shop. Address, with references, The Cincinnati Milling Machine Co., Cincinnati, O.

PENNSYLVANIA.

Draftsman wanted at $2 to $3.50 per day; location, eastern Pennsylvania. Reply to "Machine Tools," care AMERICAN MACHINIST.

Bright young man, with shop experience, to learn the fine-tool business; have good proposition; state age, experience, etc. Ernst G. Smith, Columbia, Pa.

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Large concern building excavating and railway machinery wants to correspond with first-class mechanical draftsmen, with view to filling future vacancies as they occur; wants men now employed; give full experience and reason for changing; shop experience great advantage; all letters acknowledged and held confidential. Box 919, AMER. MACHINIST.

The annual meeting of the stockholders of The Derry-Collard Co. for the election of officers, and for the transaction of such other business as may properly come before the meeting, will be held at the offices of the company, 256-257 Broadway, Manhattan, on Jan. 8, 1906, at 6 o'clock in the afternoon.

A. LEIGHTON DONNELL, Treas.

Tool Catalogue No. 22. 950 pages, bound in cloth. Greatest small-tool catalogue ever published. Will be sent post-paid on receipt of $1. Money paid for catalogue refunded with first purchase amounting to $10 or over. Book costs you nothing if you become a customer. Montgomery & Co., 109 Fulton st., New York City.

New York City, Dec. 15, 1905.

For Sale.

Second-hand lathes, 20 in. swing x 8 ft. bed; planer, 24 in. and 5 ft. bed. E. C. & A. E. Rowland, New Haven, Conn.

For Sale—10-ton crane, 40 ft. span, rope drive; has been tested to 20 tons; very low price for cash. Address Murray Iron Works Co., Burlington, Iowa.

For Sale—A bargain; 90 in. gap second-hand steam riveter, 36 in. cylinder; good as new; Wm. Sellers & Co. make; price $500. Box 923, AMERICAN MACHINIST.

For Sale—One No. 5 Rudolphi blanking press, all in first-class condition, having only been used one year; will sell at a bargain. Address Wilford Novelty Mfg. Co., St. Joseph, Mich.

For Sale—1,200-light electric plant, consisting of 100 H.-P. Payne engine and 60-kilowatt Edison dynamo; perfect condition; low price to quick purchaser. Apply to Estate of Henry C. Miner, 194 Bowery, New York.

Fine modern shop, approximately 60,000 square feet, equipped with up-to-date machinery, admirably adapted for the manufacture of automobiles and parts. Excellent location in thriving Indiana city of 20,000. Unexcelled shipping facilities. On two trunk lines. Labor first-class and moderate in price. No strikes. Capacity 200 men. Would make favorable terms. Send for full particulars. Box 937, AMERICAN MACHINIST.

For Sale or to Rent—Brass foundry, Bridgeport, Conn., opposite freight station and within 500 feet of water-front. Property consists of 113.4 square rods. Main building, 60x200 feet, and equipped with crucible (21) furnaces, trolleys, etc.; fire-proof pattern safe, coreroom and supply sheds, stamp-mill and well yielding 200 gallons per minute. Location also valuable as warehouse. Address R. H. W., P. O. Box 1358, New York.

Business Opportunities.

Wanted—Practical and thorough mechanic, as shop manager, who is willing to invest a few thousand dollars in an established machine-tool business in Cincinnati, O. "Z-25," care AMERICAN MACHINIST.

Gas engine designer, of extensive experience, has simple engine of extraordinary merits; would like to hear from capitalists or manufacturers who would be willing to go into business on large scale. Address "Four Cycle," care AMERICAN MACHINIST.

Sub-Let—Brick warehouse, Bridgeport, Conn.; two stories and high basement, with elevator; 75x150 feet, on lot 100x150 feet; directly opposite freight station, N. Y., N. H. & H. R. R. Present lease expires April, 1907. Address R. H. W., P. O. Box 1358, New York.

Owner of pattern-making business netting over $3,500 per annum retires in January. Foreman having charge of plant for the last 8 years will join with a competent man having $2,000 to invest and buy out present owner. Plant employs 18 men, has been running continually for the last 10 years, and can be obtained at a very moderate figure. Address "Foreman," care AMERICAN MACHINIST.

A mechanic, used to small die work or fine assembling, can purchase interest in a manufacturing business established 5 years and showing a good daily profit. Large and profitable orders on hand, sufficient to keep factory running for years. Company has machinery and materials worth $25,000, free and clear. Good opportunity for good mechanic with $5,000 to $10,000. Full investigation invited. Address Box 932, AMERICAN MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

MICHIGAN.

Superintendent wants position; American, age 39; educated, systematic, good mechanic and inventor; expert in brass foundry management; a hustler, and can deliver the goods. Box 938, AMERICAN MACHINIST.

NEW JERSEY.

Mechanical draftsman desires position; technical; has experience. Box 931, AM. M.

NEW YORK.

Position wanted as forge shop foreman; 15 years' experience in the business. Box 935, AMERICAN MACHINIST.

General foreman, responsible man, 36, experienced in high-grade duplicate general and mill machinery, expert machinist, wishes to make change. Pacific States preferred. Box 883, AMERICAN MACHINIST.

OHIO.

Wanted—By a practical diemaker, a position as foreman; thoroughly competent to design all kinds of dies for sheet metal work and light manufacturing; up to date in modern shop practice, and a hustler; Ohio preferred. Box 928, AMERICAN MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CONNECTICUT.

Wanted—Two floor and two planer hands on heavy work; steady work and good wages; no trouble; only first-class men wanted; state wages and experience. Farrel Foundry & Machine Co., Ansonia, Conn.

Wanted—A first-class engineer for stationary engine; one capable of handling engine and directing fireman; we operate about 400 H.-P. and use generator and electric current for about 125 H.-P.; want a thoroughly competent man. Address Box 922, AMER. MACH.

ILLINOIS.

Draftsman.—We have positions now open for draftsmen. Call or address Western Electric Co., Chicago, Ill.

Wanted—A toolmaker; must be acquainted with steam brass goods and their requirements; steady employment to a good man. Box 927, AMERICAN MACHINIST.

Salesman with mechanical education and experience in selling gasolene engine machinery especially; advise fully relative to experience, age, references and salary expected. Box 918, AMERICAN MACHINIST.

MASSACHUSETTS.

Wanted—Fellows gear shaper operators, also turret lathe men. Boston Gear Works, Boston, Mass.

Wanted—Man, between 26 and 34, with thorough mechanical experience, who has had charge of men; must be man of ideas and force. Box 87, Springfield, Mass.

Master mechanic, experienced and capable of supervising 1,000 H.-P. electric power and lighting plant, including repairs on same, millwrighting, plumbing, etc., in factory near Boston. Box 915, AMERICAN MACHINIST.

Machinists Wanted—We are increasing our force and need good all-around men for the building of special automatic machinery and jobbing. References as to character and ability required. Apply to L. F. Fales, Walpole, Mass.

MICHIGAN.

Wanted—General foreman to take active charge of iron and steel working plant; good opportunity for right man. Box 530, Lansing, Mich.

Wanted—3 or 4 first-class, A1 automatic screw machine hands; to experienced men will guarantee steady position and highest rate of wages. Answer, with reference, to Box 85, Detroit, Mich.

Wanted—Experienced machine operator for a new No. 1 Lucas horizontal boring, drilling and milling machine, in Detroit; state experience and wages. Address Box 892, AMERICAN MACHINIST.

MINNESOTA.

Wanted—Die and tool makers and bench hands, accustomed to small, accurate work; must be first class in every respect; highest wages. G. F. Kriesel, 2d st. and 5th ave., south, Minneapolis, Minn.

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Abrasive Materials—*Cont'd*

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Vitrified Wheel Co., Westfield, Mass.

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Air Lifts

Ingersoll-Rand Co., New York.

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Bartlett, E. E., Boston, Mass.
Marshall & Huschart Mach. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Wilmarth & Morman Co., Grand Rapids, Mich.

Architects
Dodge & Day, Philadelphia, Pa.

Auctioneers
Shaw & Co., New York.

Ball Bearings
See Roller Bearings.

Barrels, Steel
Lyon Metallic Mfg. Co., Chicago, Ill.

Bars, Boring
Beaman & Smith Co., Prov., R. I.
Cleveland Twist Drill Co., Cleveland, O.
Elmes Engineering Works, Chas. F., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.,
Three Rivers Tool Co., Three Rivers, Mich.
Underwood & Co., H. B., Philadelphia, Pa.,

Bars, Boring Cylinder
Underwood & Co., H. B., Philadelphia, Pa.,

Belt Connectors
Ellis Co., H. G., Clearfield, Pa.

Belt Dressing
Dixon Crucible Co. Jos., Jersey City, N. J.
Shultz Belting Co., St. Louis, Mo.

Belt Filler
Schieren & Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.

Belt Lacing Machine
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.

Belting, Leather
Schieren & Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Bending Machinery, Plate
Hilles & Jones Co., Wilmington, Del.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Bending Machines, Hydraulic
Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Bending Machines, Power
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Boynton & Plummer, Worcester, Mass.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Bending Tools, Hand
Wallace Supply Co., Chicago, Ill.

Bicycle Parts
Standard Welding Co., Cleveland, Ohio.

Blanks, Nuts and Screws
Whitman & Barnes Mfg. Co., Chicago, Ill.

Blocks, Chain
See Hoists, Hand.

Blowers
Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Chicago Flexible Shaft Co., Chicago, Ill.
General Electric Co., New York.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Blue Print Machines
General Electric Co., New York.
Keuffel & Esser Co., New York.

Boilers
Struthers-Wells Co., Warren, Pa.

Bolt and Nut Machinery
Acme Machy. Co., Cleveland, O.
Boynton & Plummer, Worcester, Mass.
Detrick & Harvey Mach. Co., Baltimore, Md.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Landis Mach. Co., Waynesboro, Pa.
Lang Co., G. R., Cincinnati, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Reliance Mach. & Tool Co., Cleveland, O.
Standard Engineering Works, Ellwood City, Pa.
Vandyck Churchill Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Webster & Perks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Bolts, Coupling
Cleveland Cap Screw Co, Cleveland, O.
National-Acme Mfg. Co., Cleveland, O.

Bolts and Nuts
Cleveland Cap Screw Co., Cleveland, O.
National-Acme Mfg. Co., Cleveland, O.

Books, Mechanical
American School of Correspondence, Chicago, Ill.
Audel & Co., Theo., New York.
Henley Pub. Co., Norman W., New York.
Hill Pub. Co., New York.
Modern Machy. Publishing Co., Chicago, Ill.
Wiley & Sons, Jno., New York.

Boosters
C & C Elec. Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
General Elec. Co., New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Boring and Drilling Machines, Horizontal
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Betts Mach. Co., Wilmington, Del.
Binsse Mach. Co., Newark, N. J.
Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Lucas Mach. Tool Co., Cleve., O.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pawling & Harnischfeger, Milwaukee, Wis.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. & Tool Co., Ridgway, Pa.
Springfield Mch. Tool Co., Springfield, O.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Boring and Turning Mills
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.

Boring and Turning Mills *Continued*
Colburn Mch. Tool Co., Franklin, Pa.
Gisholt Mach. Co., Madison, Wis.
Harrington, Son & Co., Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
King Mach. Tool Co., Cincin., O.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Poole Co., J. Morton, Wilmington, Del.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. & Tool Co., Ridgway, Pa.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boring Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Bown Mach. Co., Battle Creek, Mich.

Boxes, Tote
Lyon Metallic Mfg. Co., Chicago, Ill.

Brackets, Lamp
Standard Welding Co., Cleve., O.

Bulldozers
Prentiss Tool & Supply Co., New York.

Cabinets, Tool
Armstrong Bros. Tool Co., Chicago, Ill.

Calipers
Athol Mach. Co., Athol, Mass.
Starrett Co., L. S., Athol, Mass.

Cams
Boston Gear Works, Boston, Mass.

Carborundum
See Grinding Wheels.

Castings, Brass and Bronze
Nolte Brass Co., Springfield, O.
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Castings, Die Molded
Franklin Mfg. Co., Syracuse, N. Y.

Castings, Iron
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Massey Mach. Co., Watertown, N. Y.
Poole Co., J. Morton, Wilmington, Del.
United Engineering & Fdry. Co., Pittsburg, Pa.
U. S. Foundry & Sales Co., South Norwalk, Conn.
Yale & Towne Mfg. Co., Stamford, Conn.

Castings, Steel
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Kent & Co., Edwin R., Chicago, Ill.

Cement, Cast Steel
Clark Cast Steel Cement Co., Shelton, Conn.

Centering Machines
Hendey Mach. Co., Torrington, Conn.
Hill, Clarke & Co., Boston, Mass.
Phoenix Mfg. Co., Hartford, Ct.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Centers, Planer
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Woodward & Powell Planer Co., Worcester, Mass.

Chains, Driving
Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Boston, Mass
Cullman Wheel Co., Chicago, Ill.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link Belt Engr. Co., Phila., Pa.

Chains, Driving *—Continued*
Morse Chain Co., Trumansburg, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Chisels, Cold
Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Chucking Machines
American Tool Works Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Gisholt Mach. Co., Madison, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co, Cleveland, O.
Cushman Chuck Co., Hartford, Ct.
Goodell-Pratt Co., Greenfield, Mass.
Horton & Son Co., The E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Modern Tool Co., Erie, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Chucks, Lathe
Cushman Chuck Co., Hartford, Ct.
Gisholt Mach. Co., Madison, Wis.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., The E., Windsor Locks, Conn.
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Planer
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.

Chucks, Split
Rivett Lathe Mfg. Co., Boston, Mass.

Circuit Breakers
Crocker-Wheeler Co., Ampere, N. J.
Cutler-Hammer Clutch Co., Milwaukee, Wis.
General Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Switchboard Equipment Co., Bethlehem, Pa.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

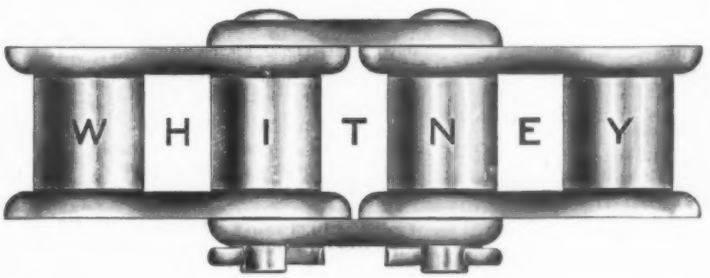
Clamps
Billings & Spencer Co., Hartford, Conn.

Clutches, Friction
Caldwell, Son & Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Johnson Mach. Co., Carlyle, Hartford, Conn.
Link-Belt Engineering Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.
Wood's Sons, T. B., Chambersburg, Pa.

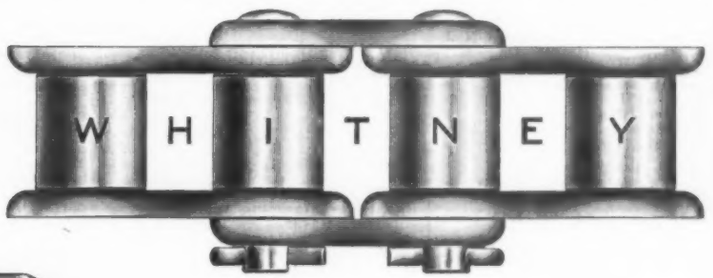
Clutches, Magnetic and Electrical
Cutler-Hammer Clutch Co., Milwaukee, Wis.

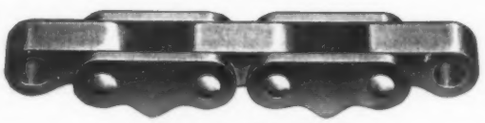
Coal Handling Machinery
Link-Belt Engineering Co., Philadelphia, Pa.

"WIZARD" Chains and Sprockets—Patented

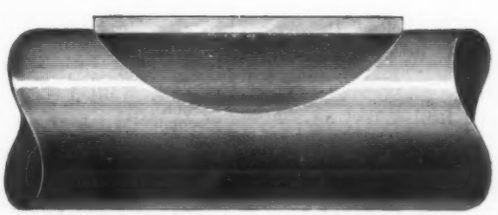


1906 Model "Whitney" Detachable Roller Chains—Patented

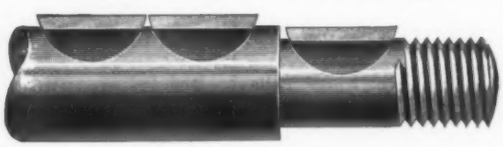




Block Chains



"Woodruff" Patent Keys



Three Popular Specialties

"Whitney" Chains
Hand (feed) Milling Machines
The Woodruff Patent System of Keying

THE WHITNEY MFG. COMPANY

HARTFORD, CONN., U.S.A.

FOREIGN AGENTS: C. W. Burton, Griffiths & Co., Great Britain. Schuchardt & Schutte, Germany, Austria, Holland, Russia and Scandinavia. Fenwick, Freres & Co., France, Belgium, Italy, Switzerland, Spain and Portugal

Coils
Standard Welding Co., Cleve., O.

Compound, Boiler
Advance Mfg. Co., Kalamazoo, Mich.

Compound, Pipe Joint
Dixon Crucible Co., Jos., Jersey City, N. J.

Compressors, Air
Blaisdell Mchy. Co., Bradford, Pa.
Blanchard Mach. Co., Boston, Mass.
Bury Compressor Co., Erie, Pa.
Christensen, N. A., Milwaukee, Wis.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Mietz, August, New York.

Compressors, Gas
Ingersoll-Rand Co., New York.

Condensers
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.

Conduit, Interior
Sprague Elec. Co., New York.

Cones, Friction
Evans Friction Cone Co., Boston, Mass.

Connecting Rods and Straps
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work
Blanchard Mach. Co., Boston, Mass.

Controllers and Starters, Electric Motor
Crocker-Wheeler Co., Ampere, N. J.
Cutler-Hammer Clutch Co., Milwaukee, Wis.
General Elec. Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Correspondence Schools
See Schools, Correspondence.

Cotters
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Counterbores
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Provi., R. I.

Counters, Machinery
Veeder Mfg. Co., Hartford, Conn.

Countershafts
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Builders' Iron Fdry., Prov., R. I.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Countershafts, Speed Changing
Cresson Co., Geo. V., Phila., Pa.
Gisholt Mach. Co., Madison, Wis.
Reeves Pulley Co., Columbus, Ind.
Speed Changing Pulley Co., Indianapolis, Ind.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.

Couplings, Hose
Ingersoll-Rand Co., New York.

Couplings, Shaft
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Link-Belt Engineering Co., Philadelphia, Pa.

Couplings, Shaft—*Continued*
Nicholson & Co., W. H., Wilkesbarre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Standard Gauge Steel Co., Beaver Falls, Pa.
Woods Sons, T. B., Chambersburg, Pa.

Cranes
Brown Hoisting Mach. Co., New York.
Case Mfg. Co., Columbus, O.
Cleveland Crane & Car Co., Wickliffe, O.
Crescent Forgings Co., Oakmont, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Nicholls, Wm. S., New York.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Phila., Pa.
United Engineering & Fdry. Co., Pittsburg, Pa.
Vandyck Churchill Co., New York.

Cranes, Portable
Franklin Portable Crane & Hoist Co., Franklin, Pa.
Nicholls, Wm. S., New York.

Crank Pin Turning Machine
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa

Crank Shafts
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.

Crushers
Ingersoll-Rand Co., New York.
Link-Belt Engineering Co., Philadelphia, Pa.

Cupolas, and Ladles, Foundry
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cups and Covers, Oil
Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Winkley Co., Hartford, Conn.

Cut Meters
Warner Instrument Co., Beloit, Wis.

Cutters, Milling
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Ingersoll Milling Mach. Co., Rockford, Ill.
International High Speed Steel Co., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gauge & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Fawcus Mach. Co., Pittsburg, Pa.
Hill, Clarke & Co., Boston, Mass.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

Cutting-off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Fitchburg Machine Works, Fitchburg, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Diamond Tools
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Francis Co., Hartford, Conn.

Dies, Sheet Metal
American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Kent & Co., Edwin R., Chicago, Ill.

Dies, Sub-Press
Risdon, S. A., Waterbury, Conn.
Waltham Machine Works, Waltham, Mass.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Modern Tool Co., Erie, Pa.
Pratt & Whitney Co., Hartford, Conn.
Reliance Mach. & Tool Co., Cleveland, O.
Swaine Co., Fred J., St. Louis, Mo.

Dowel Pins
Winkley Co., Hartford, Conn.

Drafting Machines
Universal Drafting Mach. Co., Cleveland, O.

Drawing Boards and Tables
Rich, J. & G., Philadelphia, Pa.
Keuffel & Esser Co., New York.

Drawing Instruments
Keuffel & Esser Co., New York.

Drawing Materials
Alteneder & Sons, Theo., Philadelphia, Pa.
Rich, J. & G., Philadelphia, Pa.

Drift Bolt Drivers
Ingersoll-Rand Co., New York.

Drilling Machines, Bench
American Watch Tool Co., Waltham, Mass.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Goodell-Pratt Co., Greenfield, Mass.
Ingersoll-Rand Co., New York.
McGeorge & Sons, Cleveland, O.
Patterson Tool & Supply Co., Dayton, O.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler
American Tool Wks. Co., Cin., O.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drilling Machines, Multiple Spindle
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Fenn-Sadler Mach. Co., Hartford, Conn.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchy. Co., Chicago, Ill.
McCabe, J. J., New York.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Three Rivers Tool Co., Three Rivers, Mich.

Drilling Machines, Portable
Cincinnati Elec. Tool Co., Cin., O.
Coates Clipper Mfg. Co., Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Dreses Mach. Tool Co., Cin., O.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mach. Co., Chicago, Ill.
McCabe, J. J., New York.
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York
Ridgway Mach. Tool Co., Ridgway, Pa.
Vandyck Churchill Co., New York.

Drilling Machines, Turret
Niles-Bement-Pond Co., New York.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Fairbanks Co., New York.
Fenn-Sadler Mach. Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson Tool & Supply Co., Dayton, O.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Machine Tool Co., South Bend, Ind.,
Vandyck Churchill Co., New York.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Whitney Mfg. Co., Hartford, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drills, Center
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.
Standard Tool Co., Cleveland, O.

Drills, Hand
Dallett Co., Thos. H., Phila., Pa.
Cincinnati Electrical Tool Co., Cincinnati, O.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Pneumatic
Cleveland Pneu. Tool Co., Cleveland, O.
General Pneu. Tool Co., Montour Falls, N. Y.
Independent Pneumatic Tool Co, Chicago, Ill.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Brown & Sharpe Manufacturing Company

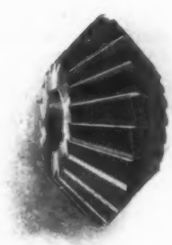
Providence, R. I., U. S. A.

A Feature of the B. & S. Cutters

is their unusual efficiency

They stand up under severe strain, and after long service do accurate work.

They are proportioned throughout to insure the greatest rigidity and durability.



The hardening and tempering are given special attention, the methods employed being the outgrowth of nearly 40 years' experience.

The space between the teeth is ample to prevent the chips crowding and thus heating the cutter.

Careful study has produced correct angles for the teeth for different kinds of work.

Cutter list, showing 36 styles and 3,700 sizes, sent to any address.

Drills, Rail
Foote, Burt & Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Standard Tool Co., Cleveland, O.

Drills, Ratchet
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Curtis & Curtis Co., Bridgeport, Conn.
Hisey-Wolf Mach. Co., Cincin., O.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rogers, Boat, Gauge & Drill Wks., John M., Gloucester City, Mass.
Standard Tool Co., Cleveland, O.

Drills, Rock
Ingersoll-Rand Co., New York.
Northern Elec. Mfg. Co, Madison, Wis.

Drills, Spindle
Three Rivers Tool Co., Three Rivers, Mich.

Drying Apparatus
Sturtevant Co., B. F., Hyde Park, Mass.

Dynamos
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincin., O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Dynamotors
Sprague Elec. Co., New York.

Electrical Supplies
Cutler-Hammer Clutch Co., Milwaukee, Wis.
Electro Dynamic Co., Bayonne, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Electrically Driven Tools and Machinery
American Tool Wks. Co., Cin., O.
Cincinnati Electrical Tool Co., Cincinnati, O.
Crescent Forgings Co., Oakmont, Pa.
Hisey-Wolf Mach. Co., Cincin., O.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Morse, Williams & Co., Phila., Pa.

Emery Wheels
See Grinding Wheels.

Emery Wheel Dressers
Desmond-Stephan Mfg. Co., Urbana, O.
Francis & Co., Hartford, Conn.
Heald Machine Co., Worcester, Mass.
International Specialty Co., Detroit, Mich.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engineers, Consulting and Mechanical
Dodge & Day, Philadelphia, Pa.

Engineers, Electrical
Crocker-Wheeler Co., Ampere, N. J.

Engines, Automobile
Franklin Mfg. Co., Syracuse, N. Y.
Olds Gasoline Engine Works, Lansing, Mich.
Reeves Pulley Co., Columbus, O.
Robertson Mfg. Co., Buffalo, N. Y.

Engines, Gas and Gasoline
Automatic Mach. Co., Bridgeport, Conn.
Backus Water Motor Co., Newark, N. J.
Blaisdell Machinery Co., Bradford, Pa.
Brown-Cochran Co., Lorain, O.
Columbus Mach. Co., Columbus, O.
Foos Gas Engine Co., Springfield, Ohio.
Jacobson Mach. & Mfg. Co., Warren, Pa.
Mietz, August, New York.
New Era Gas Engine Co., Dayton, Ohio.
Olds Gasoline Engine Wks., Lansing, Mich.
Struthers-Wells Co., Warren, Pa.

Engines, Oil
Mietz, August, New York.

Engines, Steam
Buffalo Forge Co., Buffalo, N. Y.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Struthers-Wells Co., Warren, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Engraving Machinery
Gorton Mach. Co., Geo., Racine, Wis.

Engravings
Springfield Photo-Engraving Co., New York.

Exhaust Heads
Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition, Machinery
Philadelphia Bourse, Phila., Pa.

Expanders, Boiler Tube
Nicholson & Co., W. H., Wilkesbarre, Pa.

Fans, Electric
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust
Buffalo Forge Co., Buffalo, N. Y.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Feathers
Standard Gauge Steel Co., Beaver Falls, Pa.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Nicholson File Co., Prov., R. I.
Reichhelm & Co., E. P., New York.

Filing Machines
Detrick & Harvey Mach. Co., Baltimore, Md.
Henry & Wright Mfg. Co., Hartford, Conn.

Filler, Iron
Clark Cast Steel Cement Co., Shelton, Conn.

Fillets, Leather
Cleveland Fillet Co., Cleveland, O.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.

Forges
Boynton & Plummer, Worcester, Mass.
Bradley & Son, C. C., Syracuse, N. Y.
Buffalo Forge Co., Buffalo, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Ingersoll-Rand Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.

Forges—*Continued*
Prentiss Tool & Supply Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Crescent Forgings Co., Oakmont, Pa.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Baldwin Steel Co., New York.
Crescent Forgings Co., Oakmont, Pa.
Heppenstall Forge & Knife Co., Pittsburg, Pa.
Kent & Co., Edwin R., Chicago, Ill.
Tindel-Morris Co., Eddystone, Pa.
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Adams Co., Dubuque, Iowa.
Ingersoll-Rand Co., New York.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Fuel Economizers
Sturtevant Co., B. F., Boston, Mass.

Furnaces, Annealing and Tempering
American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.

Furnaces, Enameling
American Gas Furnace Co., New York.

Furnaces, Gas
Am. Gas Furnace Co., N. Y. City.
Chicago Flexible Shaft Co., Chicago, Ill.
Westmacott Co., J. M., Providence, R. I.

Furnaces, Melting
American Gas Furnace Co., New York.

Furniture, Machine Shop
Merritt & Co., Philadelphia, Pa.
New Britain Mach. Co., New Britain, Conn.

Gas Blowers and Exhausters
Sturtevant Co., B. F., Boston, Mass.

Gauges, Recording
Bristol Co., Waterbury, Conn.

Gauges, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Henry & Wright Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gauge & Drill Works, Gloucester City, N. J.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gauges, Steam
Lunkenheimer Co., Cincinnati, O.

Gear Cutting Machinery
Adams Co., Dubuque, Iowa.
American Watch Tool Co., Waltham, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Morse, Williams & Co., Phila., Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Gear Cutting Machinery *Continued*
Prentiss Tool & Supply Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery
Gisholt Mach. Co., Madison, Wis.
Morse Twist Drill & Mach. Co., New Bedford, Mass.

Gears, Cut
Bair & Gazzam Mfg. Co., Pittsburg, Pa.
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis, Rodney, Philadelphia, Pa.
Earle Gear & Mach. Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mch. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Gould & Eberhardt, Newark, N. J.
Gleason Works, Rochester, N. Y.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
Massey Mach. Co., Watertown, N. Y.
Messmer Mfg. Co., Ferd., St. Louis, Mo.
Morse, Williams & Co., Phila., Pa.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cin., O.
Philadelphia Gear Wks., Philadelphia, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Rawhide
Bair & Gazzam Mfg. Co., Pittsburg, Pa.
Boston Gear Wks., Boston, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, Ohio.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Bair & Gazzam Mfg. Co., Pittsburg, Pa.
Boston Gear Wks., Boston, Mass.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Generating Sets
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Elec. Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Boston, Mass.
Triumph Elec. Co., Cincinnati, O.

Generators, Gas
American Gas Furnace Co., New York.

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Internal Grinding Machine

For Straight and Taper Work

Manufacturers who have large quantities of similar parts to finish find it a highly profitable machine.

The emery wheel base and slides are combined—one solid piece, sliding bearings of which are accurarely fitted and gibbed; also, thoroughly protected against the ingress of dust and dirt.

The work carrying head connects directly with the swiveling table through an auxiliary swivel, base of which is integral with the table.

Table is made to swivel and is graduated to read in degrees, and taper in inches per foot.

Emery wheel travel is automatic in either direction.

We are Grinding Machine Specialists

Send us sketches that we may figure on your work, and we will agreeably astonish you with the reduced cost figures.

Descriptive matter free.

No. 1 Landis Internal Grinding Machine.

Landis Tool Company, Waynesboro, Pa.

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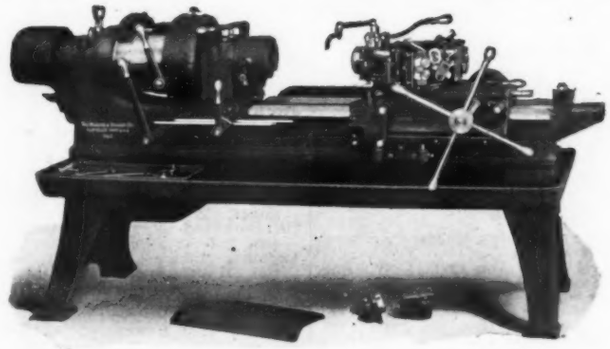
Hollow Hexagon Turret Lathes—



No. 1—1½x18". No. 2—2¼x24". No. 3—3⅝x36".

The Warner & Swasey Co.,

Cleveland, Ohio, U. S. A.

Turret Lathes and Brass Working Machine Tools.

FOREIGN AGENTS—Chas. Churchill & Co., London. Birmingham, Manchester, Newcastle-on-Tyne and Glasgow. Schuchardt & Schutte, Berlin, Vienna, St. Petersburg and Glasgow. Alfred H. Schutte, Cologne, Paris, Brussels and Milan. H. W. Petrie, Toronto. Williams & Wilson, Montreal.

QUALITY—Most modern in design—highest standard of construction—greatest accuracy in work produced.

QUANTITY of output—rapid production facilities unequalled—capable of using the *"high-speed"* steels to their limit of efficiency.

Write for the interesting particulars, or representative will call.

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Standard Gauge Steel Co., Beaver Falls, Pa.

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Obermayer Co., S., Cincinnati, O.

Grinders, Automatic Knife

Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.

Grinders, Center

Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Mfg. Co., Worcester, Mass.
Heald Mch. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Mueller Mch. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Patterson Tool & Supply Co., Dayton, O.
Rivett-Dock Co., Boston, Mass.

Grinders, Cock

Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter

Automatic Mach. Co., Greenfield, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Crocker-Wheeler Co., Ampere, N. J.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Rivett-Dock Co., Boston, Mass.

Grinders, Cylindrical

Brown & Sharpe Mfg. Co., Providence, R. I.
Heald Mach. Co., The, Worcester, Mass.
Norton Grinding Co., Worcester, Mass.

Grinders, Disk

Besly & Co., Chas. H., Chicago, Ill.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Diamond Mach. Co., Prov., R. I.
Gardner Machine Co., Beloit, Wis.
Heald Machine Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., New York.
Patterson Tool & Supply Co., Dayton, O.
Ransom Mfg. Co., Oshkosh, Wis.
Rowbottom Machine Co., Waterbury, Conn.
Safety Emery Wheel Co., Springfield, O.

Grinders, Drill

Heald Mch. Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Niles-Bement-Pond Co., New York.
Standard Tool Co., Cleveland, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Internal

Automatic Mach. Co., Greenfield, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.

Grinders, Piston Ring

Heald Mach. Co., Worcester, Mass.

Grinders, Portable

Cincinnati Electrical Tool Co., Cincinnati, O.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Tool

Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Electrical Tool Co., Cincinnati, O.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.

Grinders, Tool—*Continued*

Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Mach. Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Landis Tool Co., Waynesboro, Pa.
Modern Tool Co., Erie, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett Lathe Mfg. Co., Boston, Mass.
Safety Emery Wheel Co., Springfield, O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Grinding and Polishing Machines

Automatic Mach. Co., Greenfield, Mass.
Barnes Co., W. F. & John, Rockford, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Blount Co., J. G., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Mfg. Co., Worcester, Mass.
Crocker-Wheeler Co., Ampere, N. J.
Diamond Mach. Co., Prov., R. I.
Fairbanks Co., New York.
Gilmore Electric Co., South Boston, Mass.
Goodell-Pratt Co., Greenfield, Mass.
Greenfield Mach. Co., Greenfield, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Machine Co., Cin., O.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Patterson Tool & Supply Co., Dayton, O.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett-Dock Co., Boston, Mass.
Rivett Lathe Mfg. Co., Boston, Mass.
Royersford Fdry. & Mach. Co., Royersford, Pa.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Vitrified Wheel Co., Westfield, Mass.
Webster & Perks Tool Co., Springfield, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding Wheels

Abrasive Material Co., Philadelphia, Pa.
Adams Co., Dubuque, Iowa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Prov., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
National Corundum Wheel Co., Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Ct.

Grindstones and Frames

Athol Mach. Co., Athol, Mass.
Niles-Bement-Pond Co., New York.

Gun Barrel Machinery

Diamond Mach. Co., Prov., R. I.
Pratt & Whitney Co., Hartford, Conn.

Hammers, Drop

Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Bradley & Son, C. C., Syracuse, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Gould & Eberhardt, Newark, N. J.
Merrill Bros., Brooklyn, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Hammers, Pneumatic

Cleveland Pneu. Tool Co., Cleveland, O.
Dallett Co., Thos. H., Phila., Pa.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Hammers, Power

Bradley & Son, C. C., Syracuse, N. Y.
Fairbanks Co., New York.
Niles-Bement-Pond Co., New York.
Patterson Tool & Supply Co., Dayton, O.
Prentiss Tool & Supply Co., New York.
Scranton & Co., The, New Haven, Conn.

Hammers, Steam

Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Bradley & Son, C. C., Syracuse, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Crescent Forgings Co., Oakmont, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

Handles, Machine Tool

Whitman & Barnes Mfg. Co., Chicago, Ill.

Handles, Screw Plate

Standard Welding Co., Cleve., O.

Hangers, Shafting

Cresson Co., Geo. V., Phila., Pa.
Fairbanks Co., New York.
Hyatt Roller Bearing Co., Harrison, N. J.
Link-Belt Engineering Co., Philadelphia, Pa.
Wood's Sons, T. B., Chambersburg, Pa.

Heaters, Feed Water

Sturtevant Co., B. F., Hyde Park, Mass.

Heating and Ventilating Apparatus

Buffalo Forge Co., Buffalo, N. Y.
Sturtevant Co., B. F., Hyde Park, Mass.

Heating Machines

Am. Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.

Hoisting and Conveying Machinery

Brown Hoisting Mchry. Co., Cleveland, O.
Caldwell & Son Co., H. W., Chicago, Ill.
Cleveland Crane & Car Co., Wickliffe, O.
Cresson Co., Geo. V., Phila., Pa.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Engineering Co., Philadelphia, Pa.
Nicholls, Wm. S., New York.
Niles-Bement-Pond Co., New York.
United Engineering & Fdry. Co., Pittsburg, Pa.

Hoists, Electric

C & C Electric Co., New York.
Cleveland Crane & Car Co., Wickliffe, O.
Crocker-Wheeler Co., Ampere, N. J.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Electric Co., New York.
General Pneu. Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Sprague Electric Co., New York.
Yale & Towne Mfg. Co., New York.

Hoists, Hand

Harrington, Son & Co., Edwin, Philadelphia, Pa.
International Steam Pump Co., New York.
Moore Co., Franklin, Winsted, Conn.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic

Cleveland Pneu. Tool Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Rand Co., New York.
Nicholls, Wm. S., New York.
Northern Engineering Works, Detroit, Mich.

Hose, Steel

Sprague Elec. Co., New York.

Igniters, Gas Engine

Franklin Mfg. Co., Syracuse, N. Y.

Indicators, Speed

Norton Emery Wheel Co., Worcester, Mass.
Starrett Co., L. S., Athol, Mass.

Indicators, Speed, Peripheral

Warner Instrument Co., Beloit, Wis.

Indicators, Steam Engine

Crosby Steam Gage & Valve Co., Boston, Mass.

Indicators, Test

Reisner Mfg. Co., W. H., Hagerstown, Md.

Industrial Railways

Hunt Co., C. W., West New Brighton, N. Y.

Injectors

Desmond-Stephan Mfg. Co., Urbana, O.
International Specialty Co., Detroit, Mich.
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests

Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools

See Schools, Correspondence.

Instruments, Electric

General Electric Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.

Insurance, Boiler

Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

Jacks, Hydraulic

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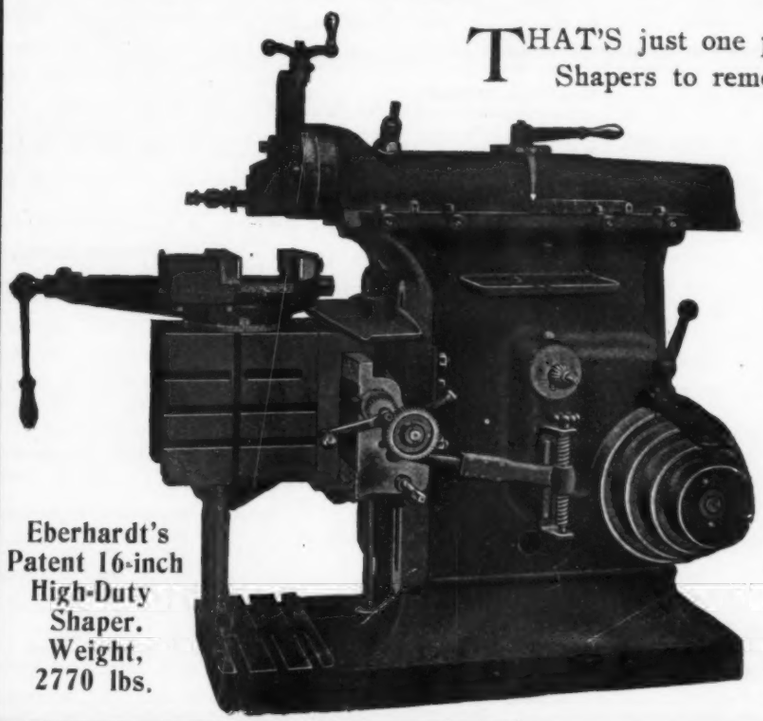

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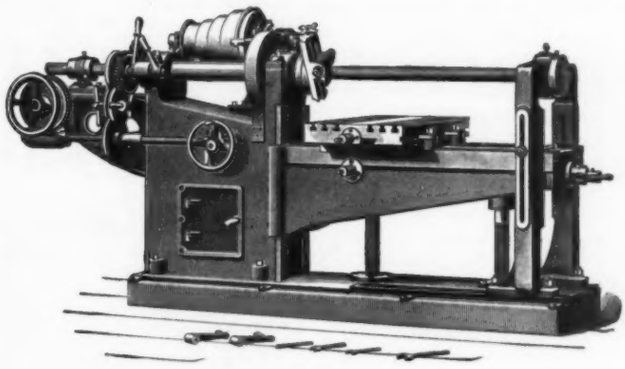

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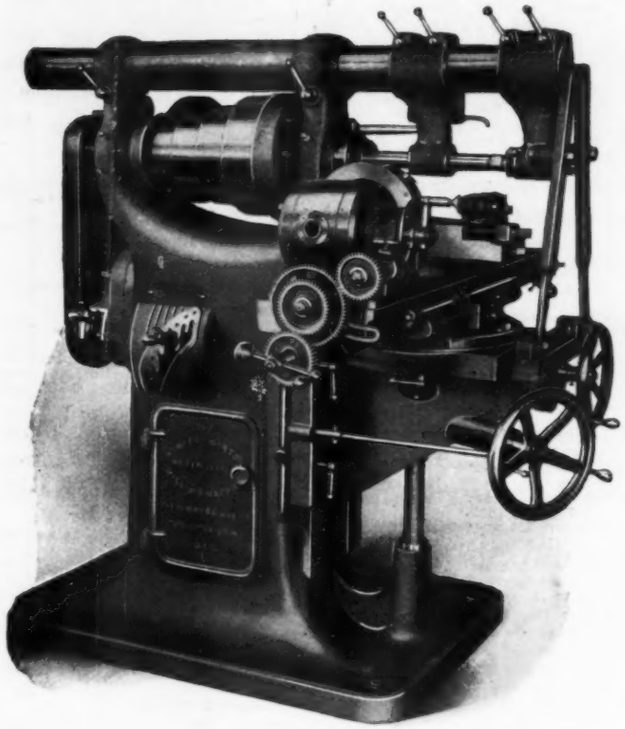

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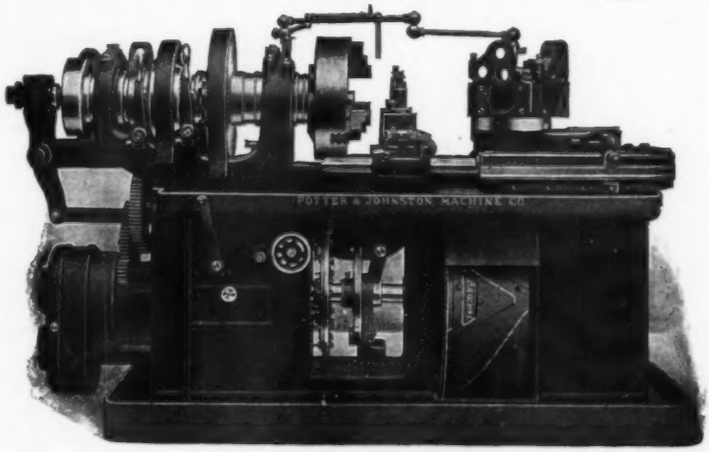

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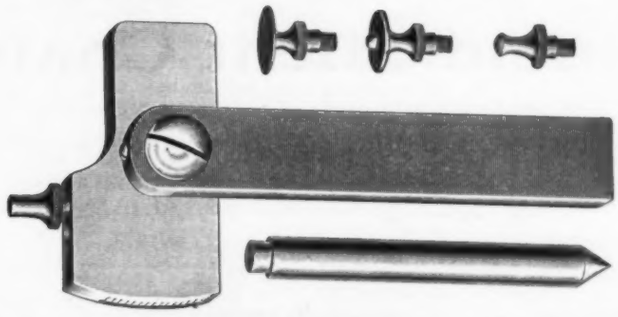

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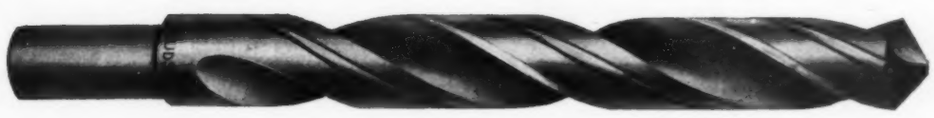

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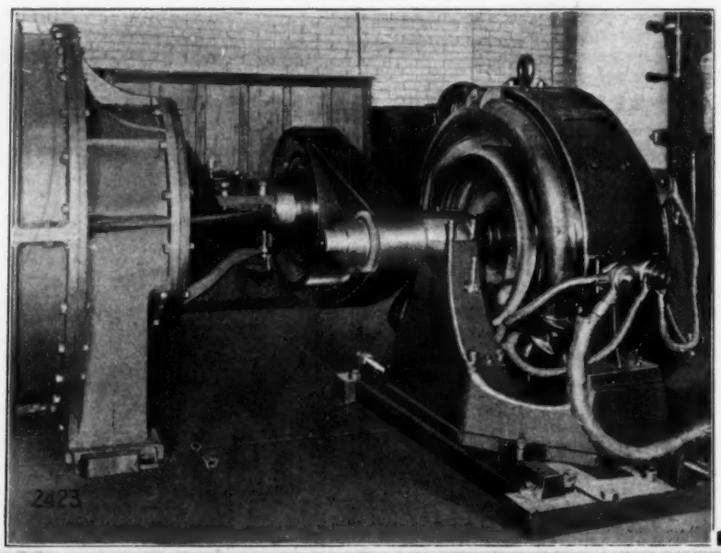

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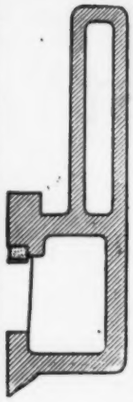

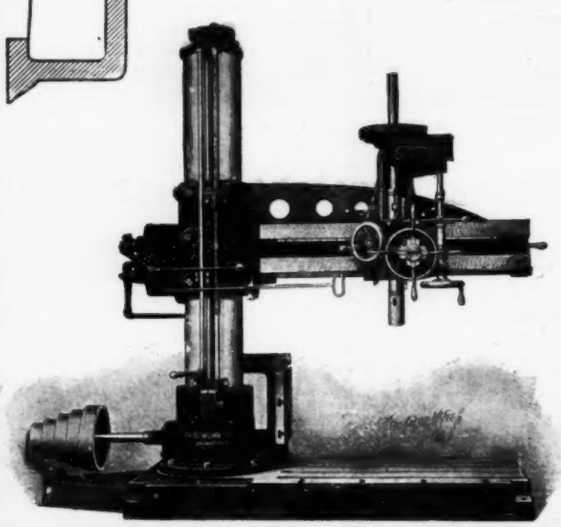

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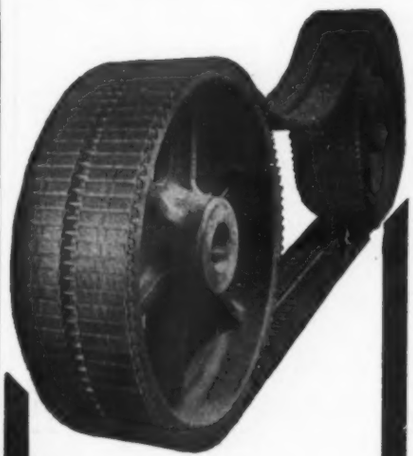

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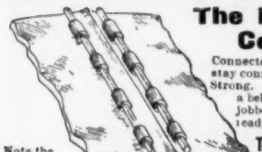

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14 x 6 C. R. & T., Lodge & Davis
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16 x 6 Swivel, P. & W
16 x 6 Plain, Flather.
16 x 6 C. R., LeBlond
18 x 8 Plain, Flather.
18 x 8 C. R., New Haven
18 x 8 C. R., Hendey.
18 x 8 C. R., McMahon & Carver
18 x 10 C. R., Nicholson & Waterman.
18 x 12 Plain, Niles.
20 x 6 R. & F., Pond.
20 x 8 C. R., Flather
20 x 8 Plain, Ames
20 x 12 R. F. Putnam.
21 x 9 C. R., Lodge & Davis
22 x 8 Plain, Niles
22 x 8 C. R., Pond
24 x 10 C. R., Fitchburg.
24 x 24 C. R., Fitchburg
24 x 10 C. R., Lodge & Davis
26 x 12 Plain, L. W. Pond.
26 x 14 Plain, L. W. Pond.
26 x 8 Plain, Pond.
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31 x 17 C. R., Lodge & Davis.
36 x 16 C. R., Niles.
36 x 18 C. R., New Haven.
48 x 10 C. R., Stearns.
50 x 16 C. R., Pond.
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16 x 16 x 42 Walters.
16 x 16 x 3 New Haven.
17 x 17 x 24 Crank, Whitcomb.
17 x 17 x 4 Draper.
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22 x 22 x 5 Putnam.
22 x 22 x 5 Lathe & Morse.
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24 in. Sliding Head, Wheeler.
24 in. Sliding Head, Blaisdell.
32 in. Sliding Hd., Lodge & Davis.
36 in. Sliding Hd., Lodge & Davis.
32 in. Sliding Head, Pond.
40 in. Sliding Head, Aurora, Tap. Att.
2½ ft. Semi-Radial, Hilles & Jones.
2 ft. Semi-Radial, Hilles & Jones.
5 ft. Semi-Radial, Barr.
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3 Spindle Adjustable Foote Burt.
14 in. 3-Spindle Gang, Hendey.
14 in. 4-Spindle Gang, Garvin.
17 in. 4-Spindle Gang, J. & L.
6-Spindle Turret, Quint.

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Hand Miller, Ames.
Index Miller, Brainard.
Horiz. Duplex, Niles.
No. 21 Vertical Table Miller, Garvin.
No. 2 Plain, Garvin.
No. 12 Plain, Garvin.
No. 1 Universal, B. & S.
No. 12 Universal Brainard.
No. 2 Lincoln, P. & W.
No. 5 Vertical B. & S.

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36 in. Turret Vertical B. & S.
4 in. Bar 9 ft. Table Horizontal, Bement.
60 in. Vertical, Niles.
Horizontal Boring Head.
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Horizontal Mill, Hoefer.
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60 in. x 14 ft. Horizontal, Pond.

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20 in. x 20 ft. Draper, compound rest P. C. F.
20-22 in. x 10 ft. Davis, compound rest P. C. F.
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30 in. x 11 ft. Pond, compound rest & P. C. F.
36 in x 21 ft. New Haven, compound rest P. C. F.
38 in. x 15 ft. and 23 ft. (Pond patent) comp. rest & P. C. F.
45-62 in. x 14 ft. Fifield, triple geared, comp. rest P. C. F.
60 in. x 27 ft. Fifield, triple geared, comp. rest P. C. F.
76 in. x 15 ft. Putnam, geared face plate.

MONITOR AND TURRET MACHINES.

12 in. x 6 ft. Niles, turret, fric. head.
No. 3 15 in. Windsor, B. G. and fric. head.
No. 5 Windsor, plain turret.
16 in. x 5 ft. American T. & M. Co.'s monitor fric. head.
16 in. x 5 ft. 6 in. Flather with turret.
18 in. x 6 ft. American T. & M. Co. Fox monitor.

SCREW MACHINES.

No. 2 Garvin wire feed. No. 3 Hartford auto.
½ in., ⅝ in. and 1 in. Cleveland automatics.
No. 1 Warner & Swasey wire feed.
No. 3 Pratt & Whitney. No. 2½ Pratt & Whitney plain.
No. 3 Pratt & Whitney back geared.
No. 3 Pratt & Whitney, plain.

BORING AND TURNING MILLS.

96 in. Bement, 1 head. W. & S. 2½ in. bar, horiz.
4 in. bar Sellers horizontal boring and drilling.
10 in. Bement car wheel borer with chuck.
3 in. bar, 5 ft. table Bement horizontal.
Keystone milling, horizontal boring and drilling, vertical adj. 6 ft., horizontal adj. 14 ft.

PLANERS.

20 x 20 in. x 5 ft. Hendey. 24 x 24 in. x 5 ft. L. W. Pond
24 x 24 in. x 6 ft. Pease. 24 x 24 in x 6 ft. Pond.
24 x 24 in. x 12 ft. Pond, 2 hds. 26 x 26 in. x 6 ft. Wheeler.
30 in. x 30 in. x 7 ft. Sellers.
32 x 32 in. x 8 ft. Lathe & Morse.
36 x 36 in. x 10½ ft. Whitworth.
36 x 36 in. x 12 ft. Powell, 3 heads.
36 x 36 in. x 17 ft. Sellers.
48 x 48 in. x 20 ft. Pond, 4 heads, parallel drive.
54 x 54 in. x 16 ft. Sellers, 18 ft., 4 heads.
88 in. x 72 in. x 33 ft. Pond, 2 heads.

SHAPERS.

18 in. Flather crank. 18 in. Wright friction.
18 in. Putnam friction. 20 in. Hendey friction.
24 in. Hendey friction.
30 in. Cincinnati double head trav. hd. shaper, 16 ft. bed (almost new).

MILLERS.

Newton plain. No. 2 Cincinnati universal.
No. 3 Kempsmith plain. No. 0 Van Norman duplex.
No. 3 Garvin plain. No. 2 Garvin bend.
No. 2 B. & S. plain. No. 3 B. & S. plain.
No. 5 B. Brainard plain. No. 4 Garvin plain.
No. 2 Garvin universal. No. 1 B. & S. universal.

DRILLS.

30 in. Prentice Bros., back geared and power feed.
12 in. Barnes friction.
60 in. Boilermakers. 6 ft. Pond radial.
4 ft. Baush radial. 35 in. Betts radial.
6 ft. Niles semi-universal. 5 ft. Hilles & Jones pin. rad

MISCELLANEOUS.

No. 14 B. & S. plain grinder.
9 in Bement cutting-off machine.
10 in. Putnam slotter. 1 Cock grinder.
1-spindle Garvin profiler. 2-spindle Pratt & Whitney profiler.
No. 7½ straight column Bliss power press.
2-spindle 4 in. capacity Whiton centering machine.
⅜ in. Adt. riveter. 10 in. Betts slotter.
4 in. Hurlburt & Rogers cutting-off machine.

We have on hand new Rogers Machine Tool Co.'s boring mills, 32 in., 38 in., 42 in., 44 in., 52 in. and 62 in., for immediate delivery.

PRENTISS TOOL & SUPPLY CO.
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507 D. S. Morgan Building, Buffalo, N. Y
535 University Block, Syracuse, N. Y.

JEFFREY Elevating, Conveying, Power Transmission, Screening, Crushing, Dredging, Coal Cutting, Drilling, Hauling, Washing Machinery. Send for our catalog.
THE JEFFREY MANUFACTURING CO., COLUMBUS, OHIO, U.S.A.

SECOND-HAND MACHINERY

LATHES.

100" x 20' Heavy Lathe.
96" Faceplate Lathe.
63" x 18' Bement Forge Lathe.
42" x 20' Draper, triple geared, latest pat.
31" x 14' Le Blond.
32" x 20' Draper, triple geared.
28" x 14' Blaisdell.
26" x 16' Draper, compound rest, latest pat.
26" x 12' Bogart, compound rest and taper.
25" x 14' Gleason, double back gears.
24" x 10' Lodge & Shipley.
22" x 12' Draper, latest pattern.
18" x 10' Lodge & Davis.
16" x 6' Bogart, with taper.
14" x 6' Flather, with taper.
14" x 6' American, 1⅝" hollow spindle.
13" x 6' Pratt & Whitney, with taper.

PULLEY MACHINERY.

48" Stevens Pulley Lathe, 2 tools.
36" Niles Pulley Lathe, 2 tools.
36" Stevens Pulley Lathe, 2 tools.
32" Newton Pulley Borer.
54" Sellers Pulley Borer.
60" Flywheel Lathe.

TURRET LATHES AND SCREW MACHINES.

42" Gisholt Gap Turret Lathe.
42" Lathe, with turret on carriage.
22" Lodge & Shipley Heavy Screw Machine.
22" Bullard Turret Brass Lathe.
24" American Turret Lathe.
2" x 24" Jones & Lamson Flat Turret.
2" American, with forming slide.

PROFILERS.

One- and two-spindle Garvin.

BORING MILLS.

20' Niles, 2 heads, modern.
84" Sellers, 2 heads, modern.
76" Bullard, latest pattern.
72" Michael, 2 heads.
30" Rogers Turret Mill.
4" Bar Betts Horizontal, 8' table.
2⅞" Bar Bement-Miles Horizontal, 8' table.
2⅞" Bar Bement-Miles Horizontal, 6' table.

GRINDERS.

Heavy Landis Universal Grinder, 20" swing, 96" centers.

MILLING MACHINES.

No. 24 Brown & Sharpe, 6' table.
Heavy Newton Slab Miller.
6—No. 2 Grant, Lincoln type.
3—No. 6 Grant, Lincoln type, heavy.
No. 12 Brown & Sharpe.
No. 13 Brown & Sharpe.
No. 16 Kempsmith.

RADIAL DRILLS.

2—2½' Tapping.
2—3' Tapping.
2—4' Tapping.
5' Universal Drill Co.
Grant Semi-Universal.

GEAR CUTTERS.

22" Gould & Eberhardt, hand feed.
30" Gould & Eberhardt, spurs and bevels.
50" Gould & Eberhardt, spurs and bevels.

HAMMERS.

1,500 lb. Bell, single frame.
6,000 lb. Morgan, double frame..
400 lb. Toledo, wth Peck lift.
80 lb. Bradley Helve Hammer.

AXLE LATHES.

No. 2B Bement-Miles. lathe pattern.
Bement-Miles Axle Centering Machine.
Bement-Miles Axle Cutting-off Machine.

PUNCHES AND SHEARS.

Pels Hand Punch. for 15" beams.

SHAPERS

16" Gould & Eberhardt, back geared.
20" Gould & Eberhardt, back geared.
24" Gould & Eberhardt, back geared.

MISCELLANEOUS.

Barr Universal Toolroom Grinder.
14" Morton Keyseater.
Morton Portable Keyseater.
86" Faceplate Lathe.
Pels Beam Punch. hand power.
4-Spindle Nut Tapper.
Whiting Elec. Gib Crane.

SLOTTERS.

9" Sellers Slotter.
10" New Haven Slotter.
15" Dill Slotter.

SEND FOR PRICES AND FULL PARTICULARS.

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HIGH GRADE PIPE CUTTING AND THREADING MACHINES. BELTED AND MOTOR DRIVEN. FOR ALL SIZES OF PIPE. WE HAVE SOME NEW IDEAS - WRITE US.
MYERSTOWN, PA.

EXPANDED METAL
LOCKERS
THE OLD STANDARD.
MERRITT & CO.
1025 Ridge Avenue, PHILA.

SECOND-HAND MACHINERY.

BORING MILLS. 1—30-in. Baush Turret. 1—51-in. Bullard, 2 heads. 1—60-in. Bullard, 2 heads.

DRILL PRESSES.
1—28-in. American. 1—No. 17 Foote-Burt Multiple.
1—8-Spindle Gardam Drill.
1—6-ft. Arm American Plain Radial.

GAS ENGINE. 100 H. P. New Era.

HAMMER. 1—50-lb. Scranton Power.

LATHES.
1—16-in. x 6-ft. Pratt & Whitney, Taper att.
1—18-in. x 8-ft. Lodge & Davis.
1—30-in. x 11-ft. Pond.
1—30-in. x 12-ft. American.
1—36-in. x 14-ft. Schumacher & Boye, Triple Geared.
1—8-ft. Pit Lathe.

MILLING MACHINES. 1—No. 9 Kempsmith, Plain.

PLANERS.
1—30-in. x 30-in. x 8-ft. Gray, 1 head.
1—30 in. x 30-in. x 12 ft. Niles, 1 head.
1—36-in. x 36 in. x 10-ft. New Haven, 1 head.
1—48-in. x 35-in. x 18-ft. Hewes & Phillips, 2 heads.
1—48 in. x 60 in. x 16-ft. Gleason.
1—60-in. x 60-in. x 14-ft. Sellers.

TURRET LATHES. 1—24-in. American.

MISCELLANEOUS.
1—15 H. P. Westinghouse Motor, 500 Volts.
1—Cincinnati Cutter Grinder.
1—Gisholt Universal Tool Grinder.
1—No. 2 Williams & White Bulldozer.
1—Class D, No. 4 Reeves Var. Speed Countershaft.
1—No. 3-B Pneumatic Compression Riveter.

THE MOTCH & MERRYWEATHER MACHINERY CO.
Successors to MARSHALL & HUSCHART MACHINERY CO., of
24 and 26 Lake St., Cleveland, O. 1025 Majestic Bldg. Detroit, Mich.

PLANERS.

We desire to call special attention to the splendid lot of Planers that we have for sale at the plant of

THE TAUNTON LOCOMOTIVE MFG. CO.

AND AT OUR WAREHOUSES.

One	Gleason Planer (4 hds.)	84" x 62" x 16'
One	Pond Planer (2 hds.)	72" x 54" x 12'
One	Sellers Planer (3 hds.)	59" x 52" x 9'
One	Sellers Planer (3 hds.)	54" x 54" x 14'
One	Fitchburg Planer (2 hds.)	42" x 42" x 16'
One	Betts Planer (1 hd.)	39" x 32" x 16'
One	Pond Planer (1 hd.)	37" x 32" x 10'
One	Powell Planer (2 hds.)	36" x 36" x 18'
One	Whitcomb Planer (1 hd.)	36" x 36" x 14'
One	Fitchburg Planer (2 hds.)	36" x 36" x 12'
One	Powell Planer (2 hds.)	36" x 36" x 10'
One	Fitchburg Planer (2 hds.)	30" x 30" x 10'
One	Putnam Planer (2 hds.)	28" x 28" x 6'
One	Powell Planer (3 hds.)	26" x 26" x 18'
One	Putnam Planer	26" x 26" x 12'
One	Fitchburg Planer	24" x 24" x 8'
Six	Fitchburg Planers	24" x 24" x 6'
One	Powell Planer	24" x 24" x 6'
One	Powell Planer	22" x 22" x 4'

Send for complete list of other Machine Tools at the works of the Taunton Locomotive Manufacturing Company. Also long list of other Second-Hand Tools that we have for sale, at our warehouses.

HILL, CLARKE & COMPANY

Boston, Mass., 156 Oliver St.
New York, 153 Greenwich St., cor. Liberty.
Chicago, 14 South Canal St.
St. Louis, 504 Fullerton Bldg.

Second-Hand Planers and Lathes

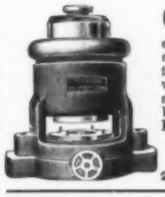
IMMEDIATE DELIVERY.

72" x 56" x 18' Gray Planer, four heads.
38" x 38" x 8' Pond Planer, one head.
36" x 36" x 12' Woodward & Powell Planer, two heads.
36" x 36" x 10' Sellers Planer, one head.
36" x 20' Betts Triple-Geared Lathe.
24" x 12½ Gleason Double-Geared Lathe, T. A.
24" x 12' Johnson Back-Geared Lathe.
18" x 6' American Cabinet Turret Lathe.

SECOND-HAND DEPARTMENT

BAIRD MACHINERY COMPANY

2515-2523 Liberty Ave., Pittsburg, Pa.



On Flat Work

our Sub-Press Dies show marked superiority. The work is always flat and not liable to be bent as with ordinary dies. We guarantee satisfaction whether you buy Sub-Press Dies or regular Punches and Dies.

S. A. RISDON

23 Jefferson St., Waterbury, Ct.

Boiler and Bridge Shop Machinery

SINGLE PUNCHES OR SHEARS.
54" throat. Capacity 2" hole in 1¼" plate, shear 1¼" plate. Belt or motor driven.
50" throat, special. Capacity two 1" holes in 1" material, cope all sections of I-beams and channels up to 24", inclusive.
36" throat. Capacity 1½" hole in 1⅛" plate, to shear 1⅛" plate. Belt or motor driven. Three.
36" throat. Capacity ⅝" hole in ⅝" plate, to shear ½" plate. Standard nose.
30" throat. Capacity ⅝" hole in ⅝" plate, to shear ⅝" plate. Architectural nose.
30" throat. Capacity ⅝" hole in ⅝" plate, to shear 7-16" plate. Architectural nose.

HORIZONTAL PUNCHES.
Two—12" throat. Capacity 1 5-16" hole in 1¼" plate. Pulley or motor driven.

GUILLOTINE FRAME BAR SHEARS.
Capacity for 2½" rounds, 6"x1¼" flats. Knives 17½" in length.

UNIVERSAL SPLITTING SHEARS.
For ¼" plate, 4"x⅝" flat bars, 1½" rounds, 3½"x3½"x⅝" angles (second-hand).
For 5-16" plate, 4"x⅝" flat bars, 1¼" rounds, 3"x3"x¼" angles. Pulley driven.

DOUBLE ANGLE SHEAR.
For shearing 4"x4"x⅝" anges. Pulley driven. (Second-hand.)

HILLES & JONES COMPANY, Mfrs.

WILMINGTON DEL.

Sebastian Lathes

When you put a small piece of work on a big lathe you're *wasting* money—when you put it on a Sebastian Lathe you're *making* money. Put all your work, from 15" swing down, on a Sebastian Lathe and you get absolute accuracy and rapidity that means profit.

Our catalog of engine and foot lathes is full of reasons why it will pay you to put in a Sebastian Lathe.

SEBASTIAN LATHE CO.,
117-119 Culver St.,
Cincinnati, Ohio, U.S.A.

SECOND-HAND BARGAINS

LATHES.

26 in. x 14 ft. Draper.	16 in. x 8 ft. Fitchburg, comp'd.
21 in. x 12 ft. Porter, 2 in. hole.	16 in. x 6 ft. Porter, 1¾ in. hole.
22 in. x 10 ft. H. B. Smith, comp.	

MILLING MACHINES.

No. 2 Brown & Sharpe Plain with centers.	Oesterlein Back Geared with Universal with automatic feed to table.

SHAPERS.

14 in. Steptoe.	16 in. Ohio.
22 in. Ohio.	15 in. Hendey Friction.

PLANERS.

28 in. x 8 ft. American—1 head.

UPRIGHT DRILLS.

12 in. LeBlond Sensitive.	22½ in. American B. G. P. F.
20 in. Sibley, B. G. P. F.	28 in. Sibley Adjustable.
4 ft. Hilles & Jones Semi-Radial.	

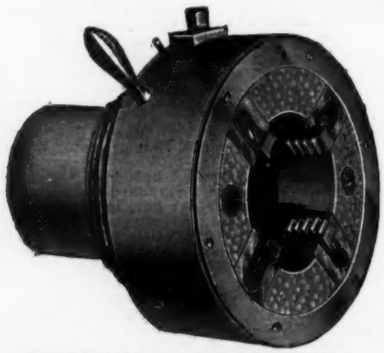
BORING MACHINES.

Fitchburg Hor. with 3 in. bar.	No. 1 Meadville Cylinder Borer, 36 in. travel.

MISCELLANEOUS.

10 in. H. B. Smith Wood Jointer.	No. 2 Pratt & Whitney Tur. Lathe, with cut-off rest.
Woodward & Rogers ⅝ in. Tap. Mch.	Bridgeport Water Tool Grinder, with wheel 24 in. x 2½ in.
Espen-Lucas 6 in. Cold Saw.	

THE FAIRBANKS CO., 701-03-05 Arch St., Philadelphia



MODERN TOOL CO.,
Box 750, ERIE, PA.

MAKERS OF

Wallace Patent Chaser Grinders, Wallace Self-Opening Dies, Solid Adjustable Dies, Adjustable Tap and Die Holders, Hollow Milling Tools, "Modern" and "Star" Tapping Attachments, "Magic" Chucks and Special Tools.

MACHINERY, SECOND-HAND

SOME LIKE NEW; OTHERS OVERHAULED, AND SOME AS RECEIVED.

(Parties, in writing, please refer to card numbers.)

ENGINE LATHES.

No. A3—13" x 5' bed, R. & F. rest, Blaisdell.
No. A55—13" x 5' bed, plain rest, Sebastian.
No. A65—13" x 6' bed, R. & F. rest, taper and ck., Pratt & Whitney.
No. A75—13" x 5' bed, R. & F. rest, with taper, Pratt & Whitney.
No. A73—13" x 5' bed, R. & F. rest, Blaisdell.
No. A1—14" x 4' bed, R. & F. rest with ck., Reed.
No. A2—14" x 4' bed, R. & F. rest and ck., raising blocks to swing 16½", Reed.
No. A19—14" x 6' bed, R. & F. rest, Reed.
No. A6—14. x 6' bed, comp. rest, Porter.
No. A9—14" x 6' bed, comp. rest and taper, "Challenge," A. M. T. Wks. Co.
No. A12—14" x 7' 4" bed, R. & F rest with ck., Reed.
No. A38—14" x 8' bed, comp. rest, Sebastian.
No. A2½—15" x 8' comp. rest and taper, Sebastian.
No. A5½—15" x 8' bed, comp. rest, Sebastian.
No. A4—15" x 6' bed, R. & F. rest, with ck., Walcott & Son.
No. A90—16" x 6' bed, plain rest, Ames.
No. A36—16" x 6' bed, comp. rest, Rahn, M. & C. Co.
No. A126—16" x 8' bed, comp. rest, Goddard.
No. A10—16" x 8" bed, comp. rest with ck., Lodge & Davis.
No. A23—16" x 8' bed, comp. rest with gap, Rahn, M. & C. Co.
No. A98—16" x 8' bed, plain rest, no name.
No. A88—17" x 6' bed, plain rest, G. A. Gray Co.
No. A11—17" x 8' bed, plain rest, G. A. Gray Co.
No. A79—18" x 6' bed, R. & F. rest, Jones & Lamson.
No. A94—18" x 8' bed, comp. rest and taper, Rahn M. & C. Co.
No. A122—19" x 7' bed, R. & F. rest, Wood. Light & Co.
No. A82—19" x 8' bed, plain rest, ck., turret on bed, raising blocks to 26", Star Tool Co.
No. A69—20" x 12' bed, comp. rest, Cincin.
No. A59—22" x 14' bed, comp. rest, W. P. Davis Co.
No. A27—22" x 12' bed, comp. rest, Draper M. T. Co.
No. A26—22" x 8' bed, comp. rest, Draper M. T. Co.
No. A113—24" x 16' bed, comp. rest and ck., Geo. W. Fifield.
No. A149—26" x 22' bed, comp. rest and ck., David W. Pond.
No. A80—30" x 25' bed, comp. rest and ck., Geo. W. Fifield.
No. A148—38" x 16' bed, comp. rest, raising blocks to 50", this size faceplate, four face-plate jaws, Geo. W. Fifield.
No. A146—50" x 21' bed, triple geared, comp. rest, Pittsburg M. T. Co.

SHAPERS.

No. A406½—6" Crank, hand and power, Boynton & Plummer.
No. A414—16" Back-Geared Crank, Gould & Eberhardt.
No. A408—16" Rack, Chase Co.
No. A425—22" Geared Rack, Lodge & Davis.
No. A413—22" Geared, Walcott & Son.
No. A401—24" Pillar Type, Friction Driven, Hendey.
No. A402—24" Regular Type, Gould & Eber.
No. A412—Die Shaper Attachment (Rochester), can be used on any milling machine with overhanging arm.

PLANERS.

No. A435—21¾" x 18½" x 4' 7" Single Head, no name.
No. A444—30" x 32" x 6' Single Head, Beardsley, K. & Co.
No. A427—30" x 30" x 7' Single Head with vise, New Haven.

PLANERS—*Continued.*

No. A426—30" x 30" x 8' Single Head with vise, L. W. Pond M. T. Co.
No. A430—33" x 33" x 8' Single Head. Cin.
No. A431—36" x 36" x 10' Two Heads. Cin.
No. A443—72" x 48" x 20' Single Head, Betts.
No. A840—14' 6½" Boiler Plate, Sellers.
No. A428—16' 2" Boiler Plate, open ends, any length can be planed, Niles.

SCREW MACHINES.

No. A289—⅝" Cleveland Auto., ratchet feed.
No. A288—⅝" Cleveland Automatic, cam f'd.
No. A290—⅝" Cleveland Auto., ratchet feed.
No. A272—No. 3 with wire feed, capacity 1½", Warner & Swasey.
No. A279—10½" with wire feed, capacity ⅞", Garvin.
No. A277—13¾" swing with wire feed, capacity 1", Pratt & Whitney.

HAMMERS.

No. A512—450 lb. Steam, No. 2 "Bell" Standard.
No. A515—450 lb. Steam, No. 2 "Bell" Standard.
No. A511—800 lb. Steam, Chambersburg.
No. A502—900 lb. Steam, open back, Trethaway.
No. A507½—200 lb. Steam, Bement, M. & Co.
No. A506—15 lb. Upright, Williams, W. & Co.
No. A502½—25 lb. Cushion Helve, Bradley.
No. A504—25 lb. Cushion Helve, Bradley.
No. A507—25 lb. Cushion Helve, Bradley.
No. A510—40 lb., No. 2 "Hawkeye," belt dr.
No. A501—Foot Power, arm and head 81 lb., face of anvil 4½ x 4½.
No. A514—Four-poppet Drop Hammer, hand lift, two heads, 46 and 80 lb.
No. A508—400 lb. Board Lift, four poppet, Bliss.
No. A509—600 lb. Board Lift, forging, Pratt & Whitney.
No. A505—1,000 lb. Board Lift, forging, Merrell.

PIPE MACHINES.

No. A485—No. 7, cap. ¼" to 2", hand and power, Jarecki.
No. A478—No. 1 "IXL," hand power, cap. ¼" to 2", solid dies, Saunders.
No. A476—¼" to 2", solid dies, hand and power, Chase.
No. A480—No. 1 Apex, ¼" to 2", right-hand, Merrell.
No. A484—No. 1 Apex, ¼" to 2", right-hand, Merrell.
No. A482—No. 1 Apex, ¼" to 2", R. & L. dies with nipple att.
No. A483—4" to 6" Curtis & Curtis, R. H., lead screw, hand and power.
No. A481—1" to 4", right-hand, quick-opening die head, Armstrong.
No. A479—2¼" to 4", worm feed, opening die head.
No. A477—2½" to 8", hand and power, Curtis & Curtis.

BOLT CUTTERS.

No. A542—⅜" to 1½", single, self-opening die heads, dies, taps, etc., Standard Machinery Co.
No. A543—⅛" to 2", single (same as above).
No. A552—1½" Double Head No. 4 Adams, self-opening die head, complete, Diedrich & Harvey.

RADIAL DRILLS.

No. A398—No. 1½ Semi-Universal, center of 9' circle, Niles.
No. A388—3' arm, Plain Standard, with tapping attachment, Fosdick.
No. A389—4' arm, Plain Standard, with tapping attachment, Fosdick.

UNCLASSIFIED.

No. C462—No. 1 Improved Automatic Surface Grinder—Diamond.

LISTS OF THE FOLLOWING SENT ON APPLICATION.

Punches and Dies, Staybolts, Chain, Anvils, Vises, Blowers, Double-End Emery Grinders, Wet Tool Grinders, Polishing Lathes and Air Hoists.

C. C. WORMER MACHINERY CO.

57-63 WOODBRIDGE STREET, W., DETROIT, MICH.

"NEW MODEL" Star Lathe Pan

Catalogue Ready

A Light, Strong, Convenient and Well Constructed

ALL STEEL LATHE PAN

Encourage and establish cleanliness in your shop by ordering now. They are Ready.

LYON METALLIC MFG. CO., 14-20 SOUTH ANN ST.-A CHICAGO, ILLINOIS

Stark Bench Lathes

are as accurate as lathes can be—have been built that way for forty-three years.

And our guarantee is one that is worth something. Catalogue No. 29 on request.

STARK TOOL CO., Waltham, Mass., U.S.A.

New 26-in. Drill with Adjustable Head.

A Powerful Machine. Nicely Balanced. Quickly Adjusted.

Screw Device operates Table. With or without Back Gears. Self Feed. Reverse motion or Automatic Stop.

It's a Labor Saver. Drill Book "C" tells you all about it.

Sibley Machine Tool Co., Successors to SIBLEY & WARE, South Bend, Ind.

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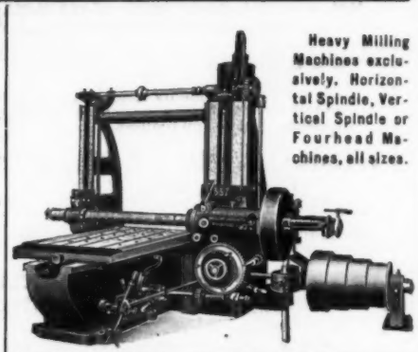

Heavy Milling Machines exclusively. Horizontal Spindle, Vertical Spindle or Fourhead Machines, all sizes.

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Universal Plain Duplex

Milling Machines

The Owen Machine Tool Company, Springfield, Ohio, U.S.A.

Hydraulic Presses and Pumps

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We'll Send a "Sable" Belt on 60 Days' Trial.

"Sable" will transmit 33⅓ more power than any oak-tanned belt you may be using, and we are anxious for the opportunity to prove it to you. That means anywhere—quarter-turn drives not excepted.

The Shultz process of tanning only the surface of the rawhide has been proven superior—gives a belt longer life as well as more pulling power. When writing ask for Booklet No. 9.

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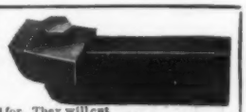
Larger output and greater accuracy in thread cutting is what "Climax" Thread Cutters stand for. They will cut about 5 times as many threads as ordinary threading tools. Let us prove it to you. Made in sharp "V," U. S. Standard and Whitworth Threads.



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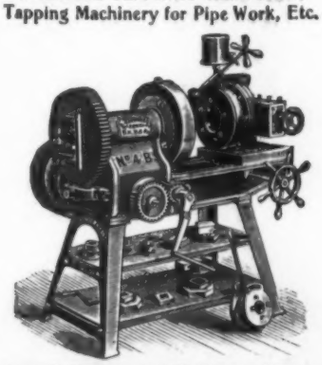
Manufacturers of

Pipe Cutting and Threading Machines

Steam and Gas Fitters' Hand Tools, Tapping Machinery for Pipe Work, Etc.



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HAND AND MACHINE BLADES OF ALL STANDARD LENGTHS AND WEIGHTS.
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for you, just to show the work of our Engraving Machine? We will make no charge and we'll tell you how long it took, so you can make some comparisons of cost and results. We'll tell you at the same time where 230 of these machines have gone and give you a chance to correspond with user. This machine engraves most anything and everything, you know, on metal or other material, always cheaper and generally better than can be done by hand. Will you have the catalog?

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because every one is tested before leaving the factory. Our Sub-Press Dies need no lining up and will produce more accurate work at less cost than other methods. Pleased to send sample of our work to those who are interested.

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To your highest productive capacity without the

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You may not think so now, but there'll come a time when you will. Why not anticipate such a time and win from the start? The Cut Meter gives you speeds in feet per minute without any fuss or bother. No rigging, or calculating. Operates in any position.

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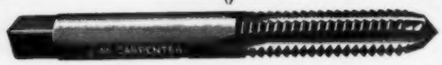

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unless you do it "deliberately and with malice aforethought." It's the bar in

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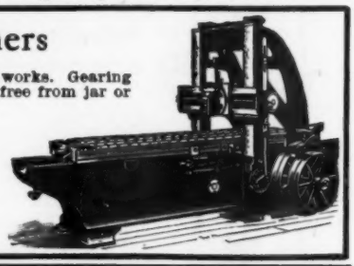

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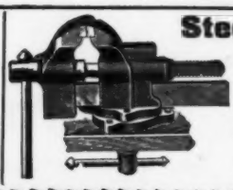

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Try one of these for better vise results.

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may break. If it happens to be a forged tool it causes a serious loss of time and material. If it is an **ARMSTRONG,** it takes but a moment to extend the blade, sharpen the point and it is ready for business.

No Forging or Tempering

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Saves 90 per cent Tool Steel

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"The Tool Holder People" CHICAGO, U.S.A.
Imitations are unsatisfactory. Infringements are unlawful.

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The Vises that we make are guaranteed to be right in every particular. It takes both skill and experience to design and put together a proper vise. Our catalog will convince you we have succeeded—it's catalog K.

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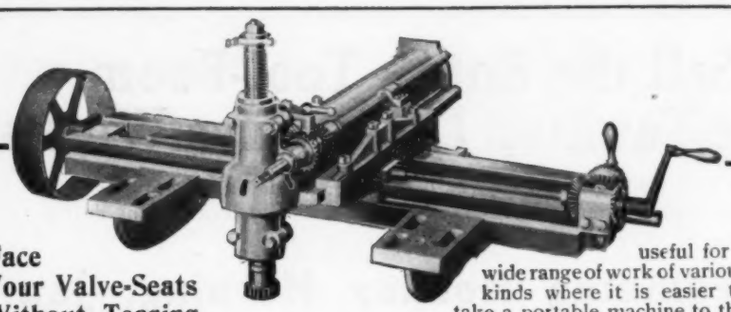

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This Portable Milling Machine will face valve-seats, and is useful for a wide range of work of various kinds where it is easier to take a portable machine to the work than to take the work to the shop. Our complete line of portable tools for boring and facing cylinders, etc., is fully described in the catalog—shall we send it?

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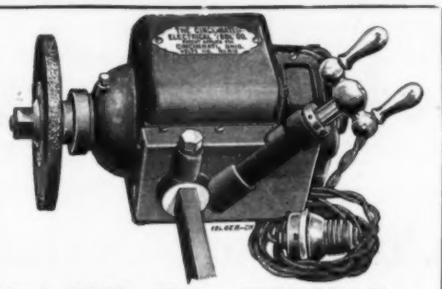

THE CINCINNATI ELECTRICAL TOOL CO., 650-652 Evans St., CINCINNATI, O., U. S. A.
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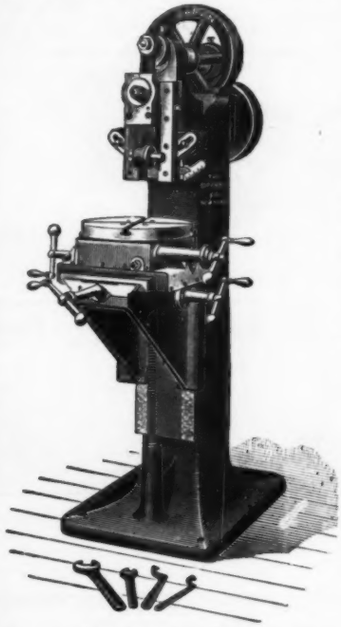

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And the lacing cannot be broken or pulled apart—at least two tests showing a tensile strain of 1,900 pounds couldn't do it—enough to meet ordinary conditions.

Another advantage—it can be connected or disconnected in a few seconds.

The joint passes noiselessly over the smallest pulley and without slipping or friction.

It won't cost anything to investigate and it may save you a great deal.

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More than a ton of Morse Twist Drills; a ton of Taps (mostly Card's); two tons of Reamers in every size up to 6"; two tons of Lathe and Planer Tools (mostly high-speed steel); one ton of Counterbores; half a ton of Master-Taps; one ton of Boring Bars and Cutters; one ton of Wrenches; Pratt & Whitney Standard Ring and Plug Gauges, Planer Gauges, Arbors, Nut Arbors, and every tool needed in the tool-room of a shop turning out the highest quality of work, will be sold in lots to suit. Most of these tools are new, in perfect condition and free from rust; and they are all the best that money could buy. Nothing but cash will buy these tools; but a little cash will go almost twice as far as it ever has before. Mail orders will be promptly and carefully filled. The tools can be seen any time before the sale. None of our own products or tools are included Come if you can; if you can't come, write, for you'll not soon have another chance like this.

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If you are interested in Disc Grinding, write for information or send samples of proposed work. Catalogue on request.

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Keyseats Cut On The Catlin

are accurately cut and cut in almost no time, so it doesn't cost you much for keyseats if you have a Catlin about the place.

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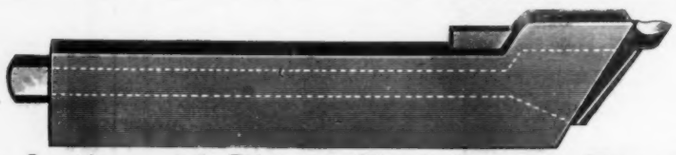

This Lathe and Planer Tool Patent For Sale

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For All Purposes.

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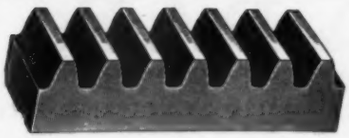

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BEAVER FALLS, PA., U.S.A.

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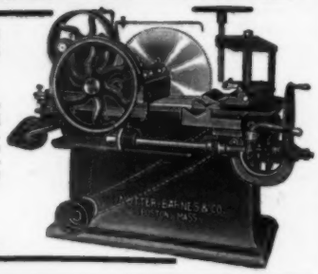

Cuts heavy, rough bar stock or finished material of any kind or shape up to 10 inches in diameter. Various quantities of small pieces can be cut at once. Has a central steel spur gear drive. Saw has quick power return. Positive gear feed drive with five changes of feed. Saws sharpened on our Automatic Saw Sharpener at slight cost. Send for Catalogue No. 10, which describes full line.

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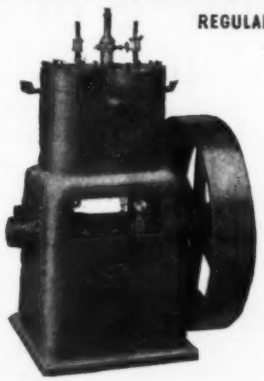

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No Dust

can get into a bearing protected by this little Oil Hole Cover. It's easily opened, easily closed, and improves the appearance of machinery. Booklet for the asking.

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Our Sand Blast Machine

has no inside hopper. Every part accessible. All wearable pieces easily replaced. Top is cone-shaped with valved opening for sand in center. Bottom valve regulates sand discharge. A first class machine in every respect. Send for prices.

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It will turn straight, taper or irregular shapes; drill, bore, ream, tap, thread, form, etc.

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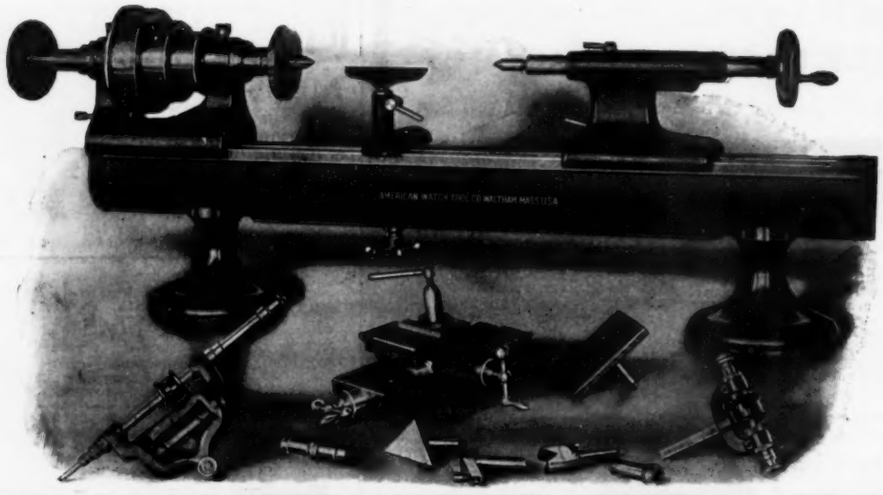
WE DESIGN, BUILD AND EQUIP MACHINE SHOPS AND FOUNDRIES.

A Specially Good Lathe for Small, Accurate Work



Our new Model No. 3 Bench Lathe was designed for precision work in the tool room or elsewhere. It has various attachments with which any work of any nature can be turned out. It's the tool inventors, model builders and fine tool makers have been looking for.

American Watch Tool Co.
Waltham, Mass., U.S.A.

1¼" Self-Oiling Bench Grinder.

Built on the same general principles as our 2" S. O. Grinder, which is giving such universal satisfaction, i. e., Dust-Proof Journal and Oil Hole Covers, Rigidity and Weight, Self-oiling Bearings, Solid Steel Spindle, Slide Rests of wide range and other good features explained in our catalogue. Write.

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The Only "Simplex" Operation Is the Pushing of a Button.

No man is too ignorant to keep his own time on it. The exact time is recorded on the time sheet by his push on the button corresponding to his number. 'Most any clerk of ordinary intelligence can check up the daily time sheets in a few minutes—it saves the salary of a regular time clerk. It brings the employees in on time and causes no delay, no crowding at the entrance. One clock at the main entrance will suffice; but if there is a clock in every department the workmen ring in near their working stations, saving a few minutes lost by each man between ringing in and getting down to work. Our booklet, "Time," contains full particulars. Ask, also, for "The Night Watchman," which tells all about the Simplex Magneto Watchman's Clock.

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Improved Universal, Plain, Disc, Face, Surface
GRINDING MACHINES,
Wire Drawing Machinery,
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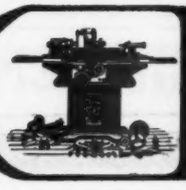

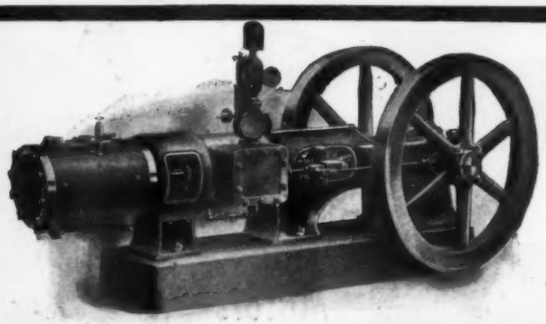

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embody every approved feature of modern practice and many original points not found in other makes.

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HOT AND COLD ROLLED HOOP, STRIP, SHEET AND BAR STEEL.

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SHEET STEEL STAMPINGS, SPECIAL DRAWN AND ROLLED SHAPES,

Dies, Tools and Automatic Machinery, Presses and Drops made to order. Welding and Brazing, Nickel, Brass and Copper Plating, Tinning, Galvanizing and Japanning.

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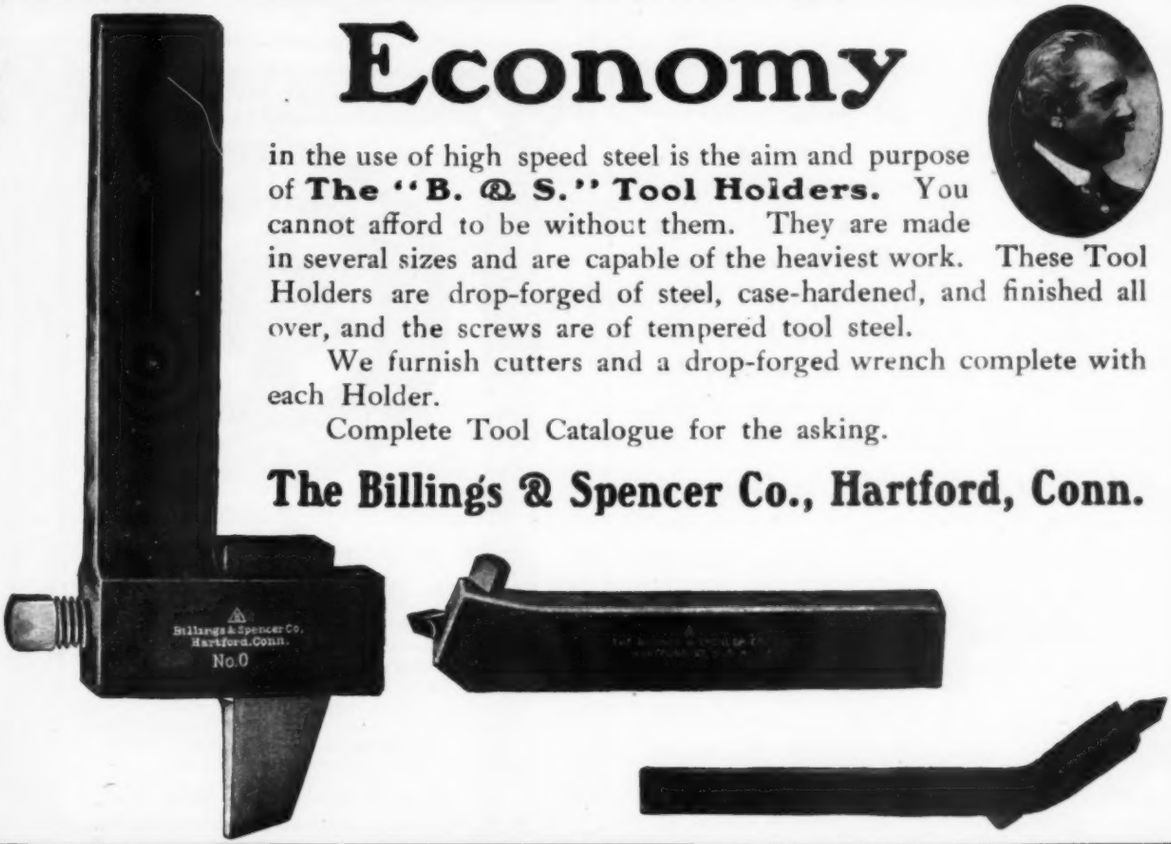
in the use of high speed steel is the aim and purpose of **The "B. & S." Tool Holders.** You cannot afford to be without them. They are made in several sizes and are capable of the heaviest work. These Tool Holders are drop-forged of steel, case-hardened, and finished all over, and the screws are of tempered tool steel.

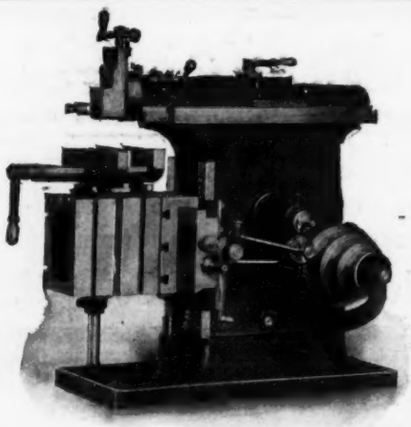
We furnish cutters and a drop-forged wrench complete with each Holder.

Complete Tool Catalogue for the asking.

The Billings & Spencer Co., Hartford, Conn.



Bay State Tap & Die Co., MANSFIELD, MASS., U.S.A. } Makers of **Fine Taps and Dies**



A high back gear ratio and plenty of material properly distributed to insure maximum stiffness under heaviest cuts, makes

The Rockford Shaper

an efficient and profitable tool for the rapid production of accurate work, using modern high speed tool steels.

Send for the Bulletin and study its construction.

Rockford Machine Tool Co.

Rockford, Illinois

TRADE SE MARK

For the Protection of Motors

TRADE SE MARK

OPEN CLOSED

You can't afford to have your motor burn out, which is liable to happen if it isn't protected by "SE" Circuit Breakers. It means too much cost, too much time lost, profit lost. It sometimes happens because a fuse fails to act quickly enough, and sometimes because a piece of copper wire is substituted for a fuse. "SE" Circuit Breakers act instantaneously; they are proof against substitution; they save the cost of fuses and the cost of delay caused by fuses burning out, and the cost of a new motor.

Bulletins tell what we haven't room to tell here.

The Switchboard Equipment Co.

BETHLEHEM, PA.

New York, 39 Cortlandt St.; Pittsburgh, Lewis Building; Portland, Oreg., Pike & Beardslee; Cleveland, Crosby, Craft & Co.; Chicago, Francis Raymond.

SOME manufacturers who attempt to make, by machine finishing methods, all the little, intricate pieces that go to make up their devices, make about as much profit as the builder who thought he could realize more money by making his own bricks.

If the little parts can be cast in dies, at less cost, with less trouble to you, involving less operating capital and in less time than required by machining, what's the reason you don't give the Franklin Process of Die Casting a trial?

It won't take long to find out what Franklin can do for you. While you think about it, send now for sample castings.

H. H. Franklin Mfg. Company,

200 So. Geddes St., Syracuse, N. Y., U.S.A.

Effect Savings up to **98%**

HESS-BRIGHT BALL-BEARINGS

are almost frictionless, as they have a mechanical efficiency of 99.88%. Ordinary hanger bearings waste from 30 to 80 per cent of power. Surely a saving like this is worthy the attention of every power user. Start your investigation to-day. Our catalog will help you. Where shall we send it? " "

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Member National Association Engine and Boat Mfrs. Member Motor and Accessory Mfrs. Association.

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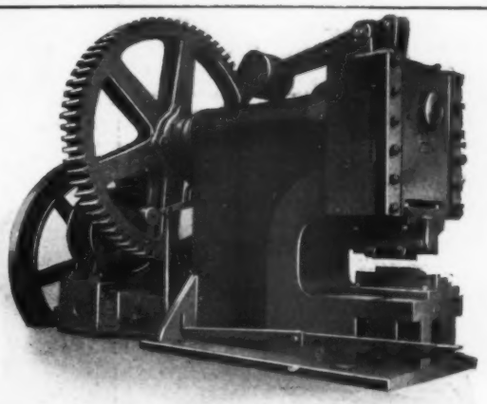
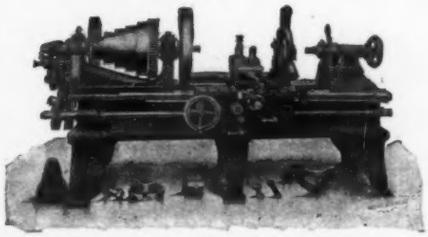
"The Largest Roll Makers in the World"
"Makers of the Largest Rolls"



United Engineering & Foundry Co.
Farmers Bank Bldg., Pittsburg, Pa.

A Lathe That Is Cheap In First Cost



is very likely to be an extravagance latterly.

A good lathe, a lathe that will afford a true and lasting satisfaction, must be properly made, and such a lathe cannot be sold cheaply, in the usual acceptance of what cheap means.

The difference of a few dollars more at first finds itself in the saving of many dollars in the end, so that, figured by results, the highest-priced lathe is the cheapest in the end.

Harrington Lathes are built as well as it is possible to build lathes. After that they are sold at a reasonable price. This price is not very much more than that of the very ordinary kinds.

They are lathes that are worth what we ask for them.

They are built in from 16″ to 54″ swing. They are solid, accurate, fast, and worthy of your critical examination.

Our catalog shows these lathes and other good tools, and can be had for the asking.

Edwin Harrington, Son & Company, Inc.
Manufacturers of Machine Tools, Chain Hoists, etc.
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VALVE STEMS

TRADE C F MARK.

We have dies for a great many varieties and sizes

HAMMERS
300 TO 6000 LBS.
CRESCENT FORGINGS CO.
OAKMONT, PA

and can make almost any kind from stock dies, nickel or carbon steel.

DROP-FORGINGS

H. H. MINER, WESTERN REPRESENTATIVE, 11 TO 13 SO. JEFFERSON STREET, CHICAGO

A WRENCH THAT WILL TURN A NUT OR PIPE OF ANY SIZE IN ANY POSITION

THE ELLIS 4 IN 1 WRENCH

Has self-locking, hinged jaws, that can be adjusted to any size of nut or pipe, at any angle, immediately.

CAN BE USED AS AN

Adjustable S Nut Wrench
Offset Adjustable S Nut Wrench
Adjustable S Pipe Wrench
Offset Adjustable S Pipe Wrench

A set of regular or special wrenches would be necessary to do the work of this wrench. Ideal for working around a corner, behind pipe and confined places. INVALUABLE TO THE MACHINIST.

We Also Carry Everything for the Machinist.

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CRANE and HOIST.
Made of Steel.
Light, Strong, Durable.
Necessity, Economic Results.
One man can operate.
You Need It.
Six Sizes:
½ to 3 tons Capacity.
Finest Testimonials.
Get further particulars.
Patent allowed.
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CRANES.
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THE EASY BLOCK

THE "TRIPLEX" BLOCK
Don't hoist your stuff by main strength. The "Triplex" way costs much less and gives the added satisfaction of getting things done quickly. "Triplex" blocks are money and muscle savers, outlifting and outlasting any other type of block. Try a "Triplex." A 30-day test is free. *NOW is the time.*
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Wide Range for Work
The new die of the Landis Bolt Cutter has a range for special work to be found in no other threading tool. Gives many times the service of a hobbed die. Requires no annealing, hobbing or re-tempering. Write for bulletin.
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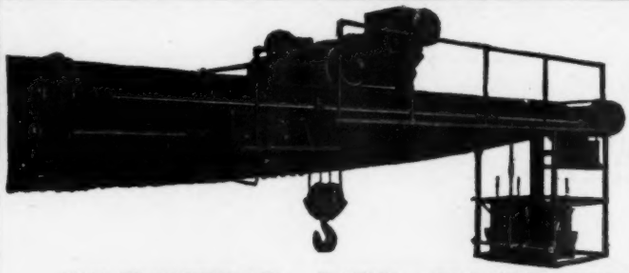
Waynesboro, Pa.

IF YOU WANT VERY GOOD CRANES GET NORTHERN.
CRANES
Electric and Hand—Send for Catalog No. 15—Free. Overhead Electric Traveling Trolley Hoists and Tracks.
NORTHERN ENGINEERING WORKS, EAST ATWATER ST., DETROIT, MICH.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ELECTRIC AND HAND-POWER CRANES
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We give especial attention to work of this nature, and are glad to furnish quotations at any time. We also pay especial attention to the developing and perfecting of intricate models.
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Saves 50% in Labor
Cars run around curves of 12 ft. radius as easily as a wagon turns a corner.
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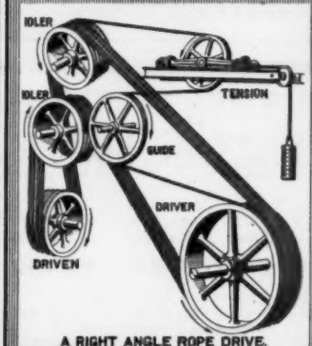

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LET US SUGGEST A DRIVE
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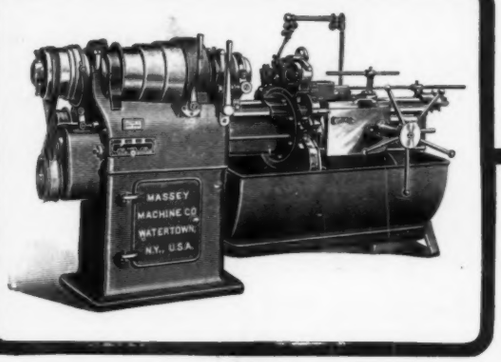

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Has

Automatic Chuck
Roller Feed
Octagon Turret, which means two more tool stations than other turret lathes.
Wide range of speeds and feeds.

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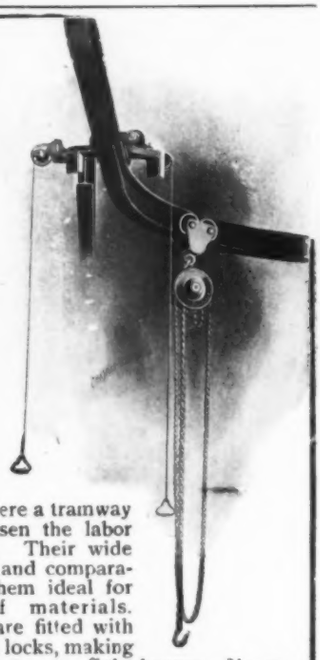

Standard Sizes Have Capacity up to 10 Tons

Designs Submitted for Heavier Loads on Receipt of Particulars

There are many shops where a tramway system would greatly lessen the labor and reduce the expense. Their wide adaptation, large capacity and comparatively small cost make them ideal for moving many kinds of materials. Switches and turntables are fitted with automatic safety stops and locks, making it impossible for the trolleys to run off the beams. If you will submit a plan giving location of curves, switches and turntables, together with the capacity wanted and other necessary details, we will be glad to send you an estimate of cost and other information of value.

THE BROWN HOISTING MACHINERY CO.
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Electric and Pneumatic Traveling Cranes and Hoists

When it is a question of head room come to us. Shepard Cranes employ spur gears throughout, machine cut. Hoist gears run in oil. Holes reamed to sizes. Structural steel trucks.

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MONTOUR FALLS, NEW YORK
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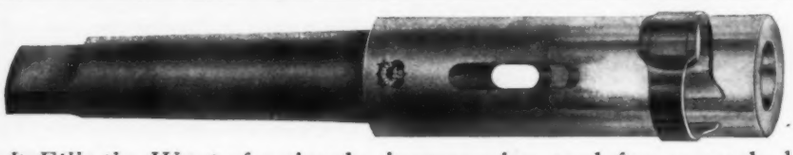
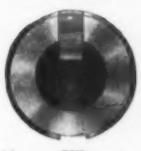


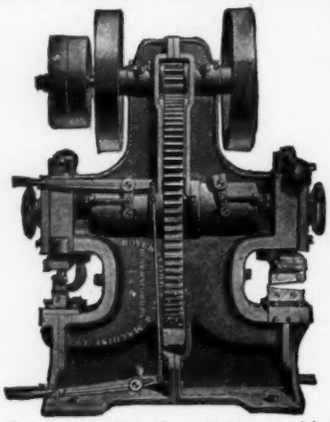


Pitkin Grip Sockets

It Fills the Want of a simple, inexpensive tool for securely holding Taper Shank Drills when the tangs are destroyed or where service is very severe. No cams, collars or other parts to go wrong.

The Standard Tool Co.
Cleveland - New York

No. 3-A Double Punch and Shear



A good, well built, reliable machine with a 10″ throat. Has structural removable jaw on punch side, making it very convenient for punching "I" Beams and Channels. Will shear 6x¾″ flat and 1½″ o iron. Will punch 1″ through ¾″ iron.

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Manufacturers of

Steam Hammers and Steam Drop Hammers, Hydraulic Riveters, Cranes and Accumulators, Forging, Flanging and Hot Presses

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"ECONOMO" EMERY WHEEL DRESSERS
"REGULAR"

LENGTH — 12 INCHES

"COMBINATION"

Made of an abrasive nearly as hard as the black diamond. Will true and shape any wheels except the very hard and carborundum. The "Combination" Dresser is the roughing Dresser placed in the "handle end" of the "Regular." It is made of corrugated steel discs and excels in wear and efficiency any Dresser heretofore made. Send for circular. Sent on ten days' trial.

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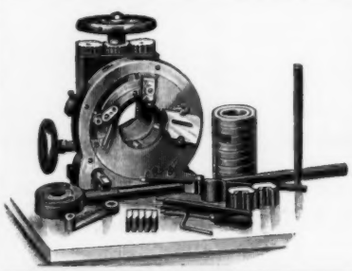
7 Holders in 1 with an assortment of 22 Tools & Fixtures

Catalog and particulars sent on request.

O. K. Tool Holder Co., Shelton, Conn., U. S. A.



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and have to be cut off or replaced in a hurry, our Hand Pipe Threading and Cutting Machine is a mighty handy and profitable tool to have around. It is portable, it has our Standard Adjustable Quick Opening and Closing Die Head, and our Improved Cutting Off Knife. It will cut and thread pipe better and quicker and easier than any other hand machine, and will make quicker changes from one size pipe to another. Four sizes: No. 5, 1 in. to 4 in. pipe; No. 6, 1 in. to 6 in. pipe; No. 9, 2½ in. to 8 in. pipe; No. 11, 4 in. to 12 in. pipe. Catalog No. 5 tells all about them.

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MANUFACTURERS OF
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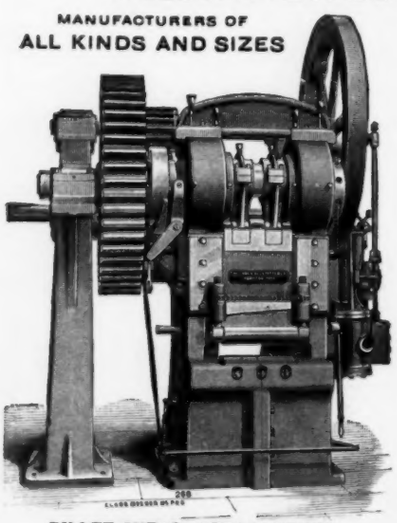

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BEYOND DISPUTE THE FINEST CUTS POSSIBLE TO OBTAIN

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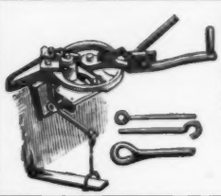

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We make hand power benders for forming eyes from stock 1½ inch thick and under. Any size eye 7 inches outside diameter and under.

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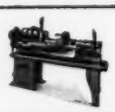

The Automatic Threading Lathe

cuts any form of threads automatically—pays for itself in a short time. For details see large ads, first and third issues each month.

Automatic Machine Co., Bridgeport, Conn., U.S.A.

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Complete equipment for practical instruction in all component parts of automobiles.
Eight weeks course assures ability of graduates. Skilful men in demand for drivers at high salaries.

BOLT CUTTERS.

Reliance are the kind that adjust quickly and stay adjusted, cut perfect threads, and never force the dies onto the threaded bolts to release them. Write for details.

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Flexible Shaft—its strength and flexibility have put it beyond all competition. Carried in stock up to 15 H. P.—above that, made to order.

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Greenerd Arbor or Mandrel Presses

for driving arbors (mandrels), bushings and pins. A general utility tool. Saves time, saves finished work and prevents springing and battering. Catalogue giving full details sent on request, or will be glad to send a press on 30 days' trial.

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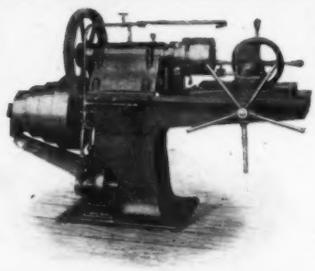

There's No Running Back Over the Work a Second Time

when the Adams Bolt Threader is used. The dies in the head release at the finish of the cut and return clear—no stripping of threads. Uniform, accurate threads, rapidly cut, are always secured with the Adams. Send for catalog.

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Are you improving in your drawing, or are you falling off? Before you can increase your salary you must increase your efficiency. The

Rich Handy Drawing Outfit

will help you to be a better draughtsman, because its use insures accuracy. It doesn't cost much.

Write for circular telling all about it.

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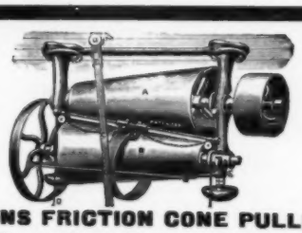

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Changing Speed of Machine while Running
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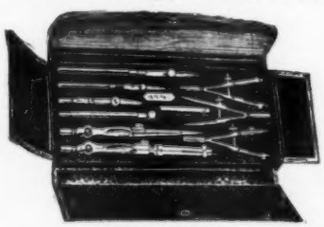

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Complete Catalogue (500 pages) sent on application.

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A MINIATURE
Micrometer Watch Charm

Made of gold and will wear for 20 years. It is perfectly graduated and will measure all sizes less than ¼ inch in thousandths of an inch. It is emblematical of the Machinist Craft and is a badge of honor.

PATENT APPLIED FOR
A HANDSOME, PRACTICAL, USEFUL
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Combination Angles Controlled by Knobs

display triangles to advantage. Special angle work greatly expedited by Base Attachment. 8-in. size, with base, $1.35; without base, $1.00. Protractor graduation, 30c. extra. Spend a cent and sense the Circulars of Celluloid Specialties.

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DROP PRESSES For All Purposes Our Specialty.

MINER & PECK MFG. CO., Proprietors of
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The Inside Links

of our new Riveted Chain have extended ends and rounded edges. Result: straight smooth, quiet running. We also make a Detachable Chain that's easy to detach, and just as reliable as a solid chain. Do you need Chains and Sprockets? We can furnish them in large quantity and high quality. Let us hear from you.

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The New Henry & Wright Ball Bearing Drill, on many jobs,

Drills From 200% to 400% More Holes

in a given time than any other drill. Send for Catalog.

A powerful drill with many improved features.

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the first and only high grade STEEL PULLEY on the market. Built on scientific principles and fully guaranteed.

Sold by Supply Houses.

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"A Piece Well Chucked Is Half Planed."

Says "Practical Planer Kinks,"

and then it tells how to chuck difficult jobs, and, in order to make everything perfectly clear, illustrates the right and wrong ways, as well as the correct clamping of the tool.

"Practical Planer Kinks" is a small book—only 80 pages, but it's a great big dollar's worth to any man who has any business around a planer, because in those 80 pages it points out the short cuts that increase the product without any "let down" in quality, often with a decided improvement.

It starts with a chapter on the planer itself, and, in succeeding chapters on

The Planer Hand or Operator, Equipment, Lining Up the "Rail," Cautions, First Lessons in Chucking, Planing Cored Work, Planing All Over, Temporary Graduations for the Planer Head, Grinding On the Planer, A Crane for Handling a Chuck, Circle Planing, A Slotting Job On the Planer, A Tool-Block Planing Fixture, Cutting Spiral Grooves On the Planer, and Planing a Large Cylinder On a Planer,

covers every important operation on that machine and how to perform it in a time-saving, labor-saving way.

It is printed in large, clear type, has 4 half-tone and 27 outline illustrations besides the author's portrait, and is well bound in green cloth, with gold title.

Nothing that a dollar can buy will make a more acceptable Christmas present for a planer operator; and there can be no better, more mutually helpful gift for an employer to give an employee.

The price, postpaid, is only $1.00.

And if you're thinking of Christmas gifts for mechanics, don't forget "Questions and Answers from the American Machinist," $1.50, and "Chordal's Letters," $2.00.

Better get our Book Catalog.

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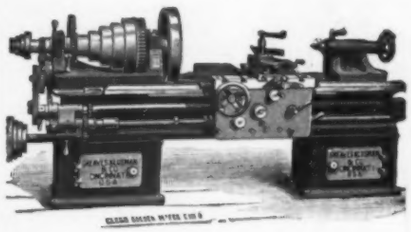

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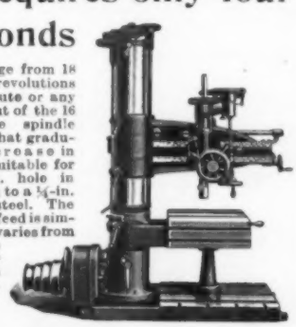

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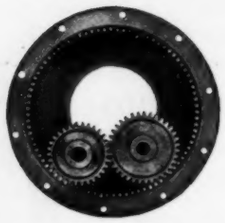

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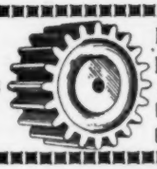

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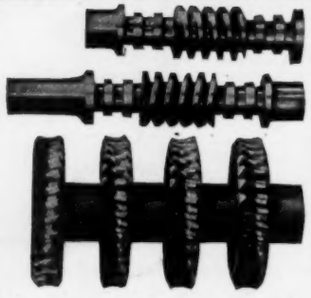

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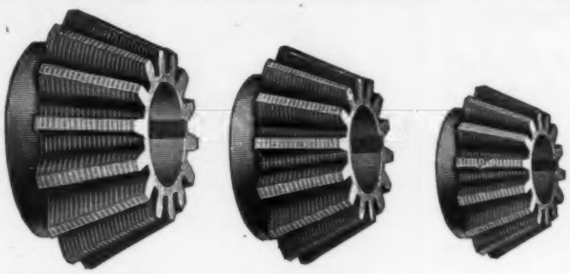

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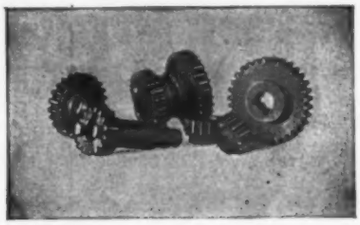

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Our gears are accurate.
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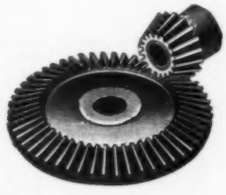

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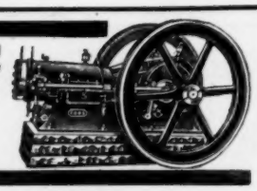

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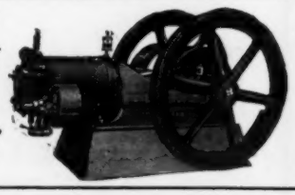

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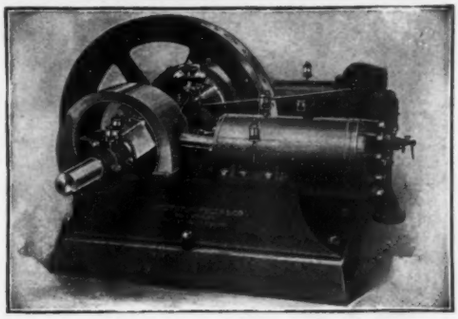

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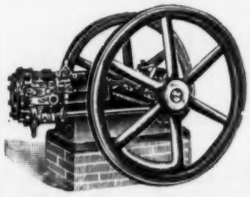

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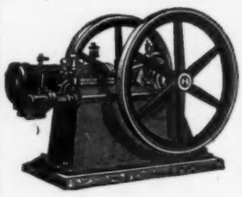

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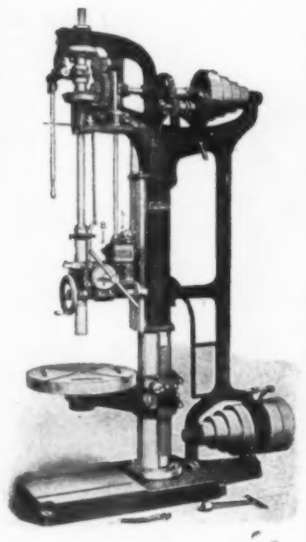

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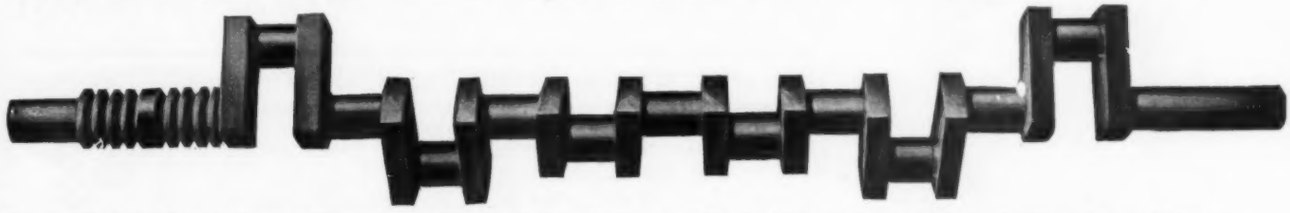

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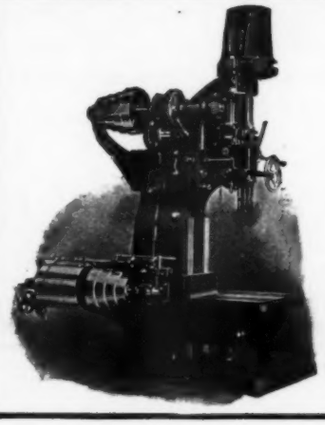

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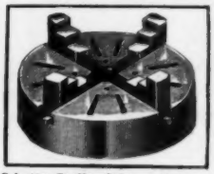

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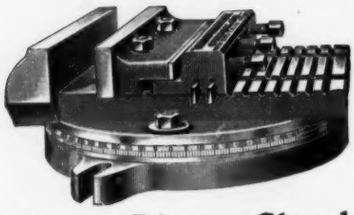

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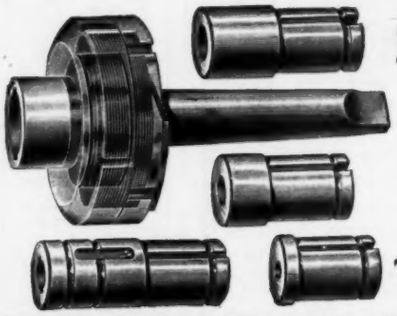

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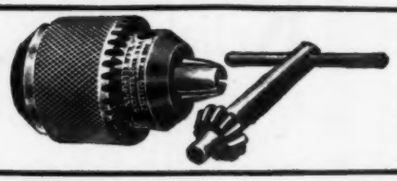

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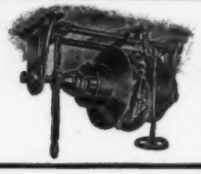
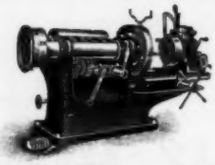


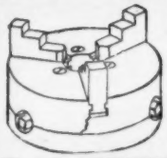


Pipe Threading Machinery

Bolt Threaders. Hand Stocks and Dies. Pipe Cutting-off Machines. Pipe Couplings for Gas Lines.

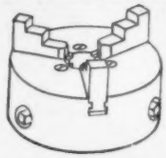
STANDARD ENGINEERING WORKS, Ellwood City, Pa., U. S. A.

New York Office: 123 Liberty St. 1012 Chemical Bldg., St. Louis, Mo.



THERE ARE NO JOINTS

in the body of Whiton Geared Scroll Chucks. Joints weaken chucks — that's why they break. Whiton Chucks are made to last.



D. E. WHITON MACHINE CO., New London, Conn.

European Address—Selig, Sonnenthal & Co., 85 Queen Victoria St., London, E. C.

"Whiton" Chucks are Sold and Kept in Stock by Principal Dealers all over Europe.

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For annealing, hardening, tempering, melting, etc. Complete line built on the most improved designs. Catalogue giving full particulars sent on request.

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Agents: Prentiss Tool & Supply Co., New York, Boston, Buffalo, Pittsburg. E. A. Kinsey & Co., Cincinnati, Ohio.

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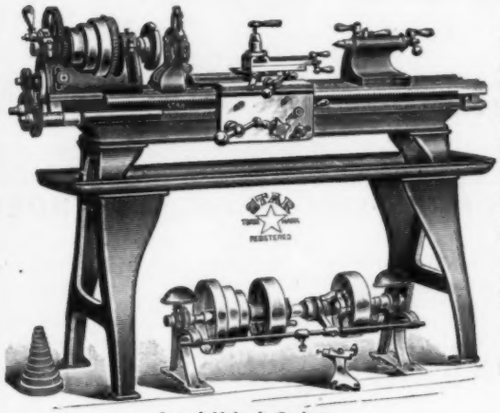
Accurate Lathes of Small Dimensions



"STAR" LATHES are designed, after years of experience, to be thoroughly accurate and reliable lathes of small dimensions, something better than any other small lathes, ever before offered at low prices. They will do much of the work now put on larger lathes, occupy less space, cost less and do more work for every dollar you have invested. That is why you should use "STAR" LATHES.

They are used by hundreds of the best mechanics throughout the United States and foreign countries.

Send for Catalog "B" giving full descriptions.

9 and 11 inch Swing
24, 36, 48 and 60 inches between centers

The Seneca Falls Mfg. Co. 687 Water Street, Seneca Falls, N. Y., U.S.A.

(109 A

ERRINGTON
AUTO-REVERSE TAPPING CHUCK.

No. 00	Taps to	3/16	Inch.
No. 0	"	5/16	"
No. 1	"	3/4	"
No. 2	"	1	"
No. 3	"	1 1/4	"
No. 4	"	1 1/2	"
No. 5	"	2	"

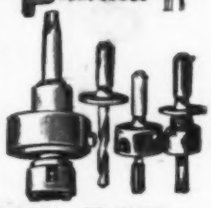
Fits any Drill Press.

Drills, Taps Sets Studs, In Line.

The Only Automatic Reverse.

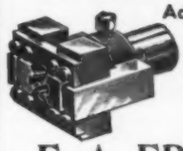
NO { STOPPING, REVERSING, MOVING WORK, CHANGING SPEED.

Quick-Change Tool Holders.



OPENING DIE.

Adjustable



No.	Std.	Pipe
1	Threads to 5/8 in.	3/4 in.
2	Threads to 1 in.	1 1/4 in.
3	Threads to 1 1/2 in.	1 in.
4	Threads to 2 in.	1 1/2 in.

Opens and Closes While Rotating.

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England: Chas. Churchill & Co., London, Birmingham, Glasgow, Manchester, Newcastle-on-Tyne. Switzerland: American Import Machinery Office, Zurich and Chaux-de-Fonds. Germany: Arthur Kayser, Berlin, S. W., Alte Jacobstrasse 34. France: Edgar Bloxham, 2 Rue du Delta, Ecuries, Paris.

Automatic Machines

for making Stove Bolts, Tire Bolts, Rivets, Lag Screws and Wood Screws.

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your men's time by using our centering machines, and your work will always be true. It saves its cost over and over again. If you want a small countershaft, what is better than ours?

The Phoenix Manufacturing Co.,
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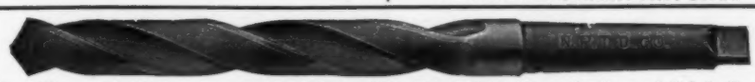

We Guarantee every one of our Hot-Forged Drills, whether of High Speed or Carbon Steel, to be tougher, stronger and more durable than any drills in use. Catalog.

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Our Hydraulic Press Packings

are made from the most carefully selected leather and may be used repeatedly without cracking or breaking. The character of the leather makes these packings cost us about double what ordinary hydraulic packings do, but they are good for more than double the service and therefore much cheaper to use. We keep all the standard shapes and sizes ready for delivery, and describe them in information sheets 429 to 434. Don't you want this information?

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Chicago Office: 453 Rookery.
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The Almond three-jaw principle has never been improved upon; Almond quality has never been duplicated in any other make. Can you contradict that?

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When You Go Calipering Through The Mandrel Pile

you are wasting a lot of time that might be saved by using Nicholson's Expanding Mandrels. Nicholson's mandrels are

always ready—solid ones never are. Nicholson's in a set of nine fit every sized hole from 1" to 7" and hold the work. "Mandrel Talk?"

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Machine Relieved
TAPS
Are the Best

Write for New Catalog No. 33, which gives full description.

Made by

Wiley & Russell Mfg. Co.
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COMPRESSION COUPLINGS
Require No Keys.

Are easy to put on or take off. Positive in action and hold shafts in perfect alignment. No keyseats necessary in shafts. A broken shaft can be repaired immediately with one of these Couplings.

For sale by dealers everywhere, or direct by us if your dealer cannot furnish.

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Manufacturers of
Shafting, Pulleys, Hangers, Friction Clutches, etc.

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Full details are in Bulletin No. 12. Send for it.

Rowbottom Machine Co.
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BUILT FOR QUICK, ECONOMICAL GRINDING

That's why the Bridgeport Motor-Driven Grinder has the finest phosphor bronze removable split sleeve bearings ring oiling, a one piece base, that has the weight and width to reduce vibration to the lowest limit, a special motor mounted in a way to relieve it of all strain—but we can't tell all its good features here.

Send to-day for catalogue.

The Bridgeport Safety Emery Wheel Co.
(Incorporated),
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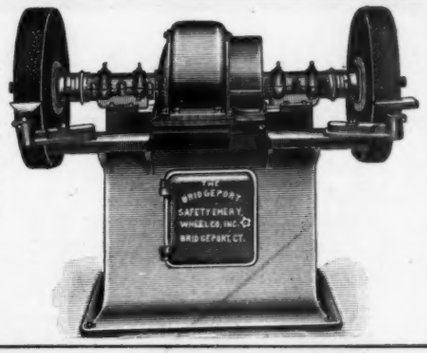
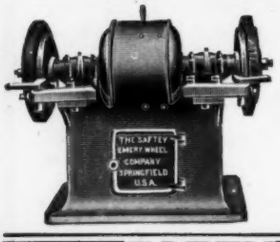


No. 21 CHAMPION MOTOR DRIVEN GRINDER.



For wheels 24" diameter. Size of motor, 7½ H.P.
Weight, 1800 lbs. Height floor to center of spindle, 32".
Length ring oiler bearings, each 12".
Diameter spindle in bearings, 2¼".
Diameter spindle between flanges, 2".
Diameter of flanges, 8". Distance between wheels, 43".
Entire length of spindle, 43½" x 27".
Machine is equipped with controller arranged for three speeds, 900, 1050 and 1200 revolutions.

SAFETY EMERY WHEEL COMPANY
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FORTY
Styles and combinations are shown in the new catalog of New Yankee Drill Grinders.
WILMARTH & MORMAN CO.
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There are a thousand and one reasons why you should use our wheels. Two of them are these: they're made of 95% pure corundum; they will not glaze nor heat. The other nine hundred and ninety-nine are in the catalog.

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THE NATIONAL CORUNDUM WHEEL CO.
BUFFALO N.Y.
THE ONLY MANUFACTURERS IN THE UNITED STATES OWNING AND OPERATING THEIR OWN MINES

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Keep Your Tool Room Emery Wheel True by Using
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Send for Dresser Booklet with Testimonials

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FRANCIS & COMPANY,
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We Are Importers And Expert Setters of Best Black Diamonds. We Make Diamond Emery Wheel Dressers As They Ought to Be Made. Ask For Circular.

ABRASIVE EMERY WHEELS

Differ from other emery wheels in at least this respect—

They don't merely grind—they "cut"—every atom—even the bond that holds the particles together.

Other wheels cost as much, some of them even more than the "abrasive."

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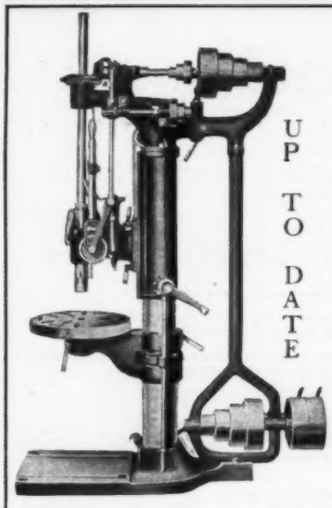
Leshure's Safety Collar Is Loaned Free to Users of the **Hampden Wheels** HAMPDEN CORUNDUM WHEEL CO., Send for Circular. Brightwood, Mass.



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NEATLY DESIGNED

Our 23-inch Slding Head Drill is a very popular size.

The Back Brace makes it an exceedingly stiff tool. It is made to stand up under hard service. Will drive high speed twist drills up to 1½ inches.

We build several larger Sliding Head Drills, all equally good, besides many Stationary Head Drills. All sizes furnished in gang of from two to six spindles. Our catalog is at your service.

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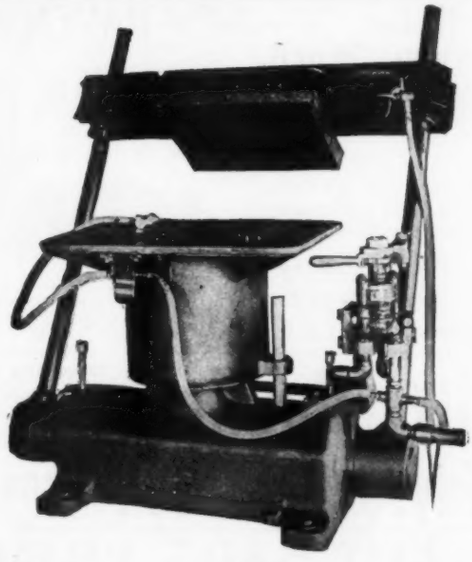

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Vibrators

Multiple Moulding
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Vertical Vibration

A New Principle in Vibrator Molding as Applied in Our Split Pattern Construction

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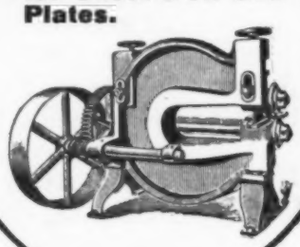
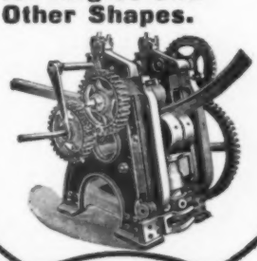
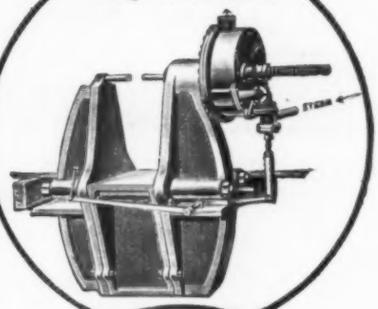
Rotary Shears for Sheet Iron and Plates.



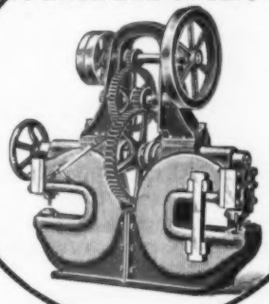
Universal Benders for Angles and Other Shapes.



Gap Riveters.



Punch and Shear.



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Blue Chip Steel

will turn off blue chips on any kind of work.

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Deep cuts at high speeds are easily taken by tools made from

"Alpha"

High Speed Steel. It holds an edge longer and cuts faster than others.

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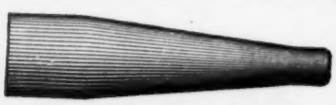

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is unequaled for twist drills, milling cutters, lathe and planer tools. Tools made from Allen's Steel stand up, under the severe strain of high-speed service, as no others will.

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IN STOCK:

No. 80 to 1", accurate to gauge, finest quality. Also square and flat drill rod stock. Also

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High Speed Steel — Cannot be excelled for Turning, Planing, Slotting and Drilling Tools.

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A Drill for Strenuous Work.

Sturdy and powerful. Built for high speeds—handy for jig work. Gear driven. Top columns swing to different centers. Write for circular.

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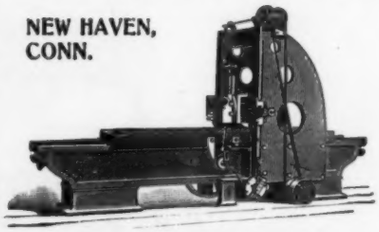

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IRON WORKING MACHINERY.

Heavy Iron Castings, Machine Molded Gears, Pattern Molded Gears and Semi-Steel Castings.

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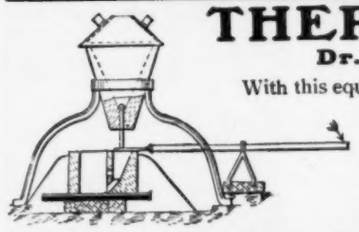

With this equipment you obtain anywhere in ½ a minute:

1. *Heat about 5400° F.*
2. *Pure Metals free from carbon,* amongst them pure steel.

You use this combination to weld iron and steel of any section, rails, girders, pipes, etc. **Titan Thermit** prevents blowholes in castings.

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We have a large plant, capable of turning out all kinds of light and heavy gray iron castings from 1 pound to 15 tons, and can give you rapid delivery. Tell us your wants and let us make you an estimate.

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About Any Sort Of Lathe Job Can Be Handled On One Spindle Or The Other

Of McCabe's New "Heavy Pattern" 26″–48″ Double Spindle Lathe.

And this wide range of usefulness—this capacity for big work on the 48″ spindle, and light work on the 26″ spindle—means that this lathe is an especially good one to buy, especially as it costs about half what an ordinary big lathe would, and gives all the advantages of two lathes while occupying the usual floor space of one. Send today for our catalog. Don't wait to hunt through second-hand lists, for these tools won't be found on them—they're too busy working.

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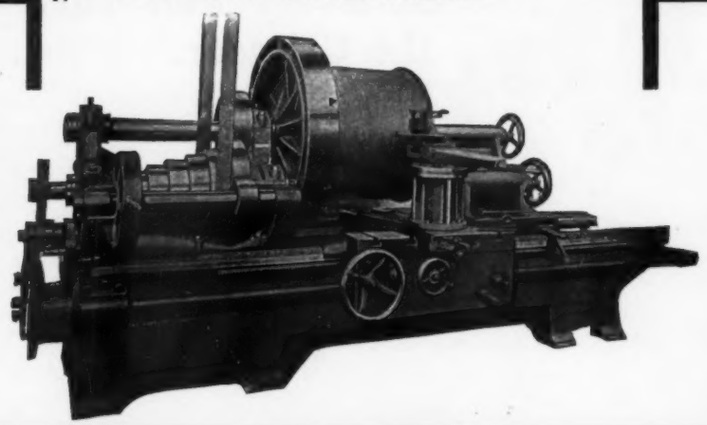
R. A. Hervey, Sidney, N. S. W., Sole Agent for Australasia.

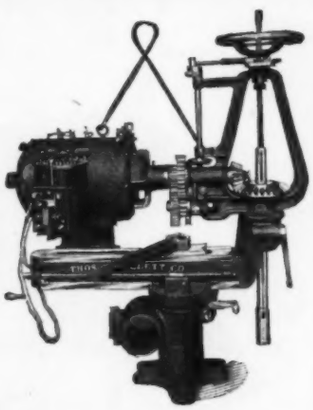


The cheapening of the cost of production is greatly facilitated by the use of

Dallett

Portable Electric, Rope Driven or hand

Drills



The best shops use them.

Thos. H. Dallett Co.,
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Good Centers are Necessary For Good Lathe Work.

With our Combination Center Drills you can drill accurate centers, with correct angles and proper clearance, without giving the work close attention. They make all work interchangeable. They can't go wrong. They are a particularly good drill for starting a hole at a sharp angle to the surface.

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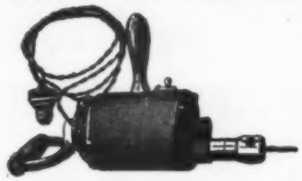

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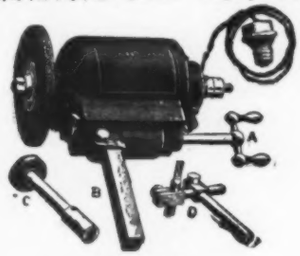
Electrical Hand or Breast Drill.
4 Sizes, ¼″, 5/16″, ⅜″, ½″ capacities. Weights, 12 to 19 lbs.



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Electrical Tool Post Grinder.
For grinding centers, cutters, internal and surface grinding Set in Lathe, Planer or Milling Machine.
3 Sizes of ¼, ⅓, 1 Horsepower. Weights, 16 to 78 lbs.

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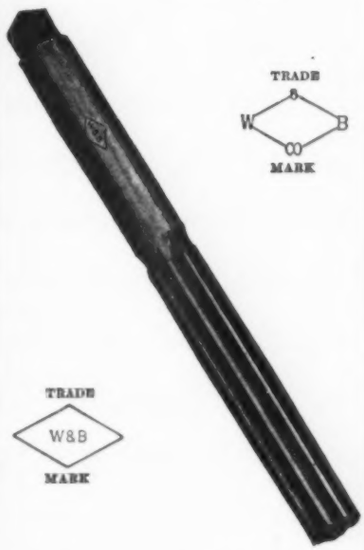

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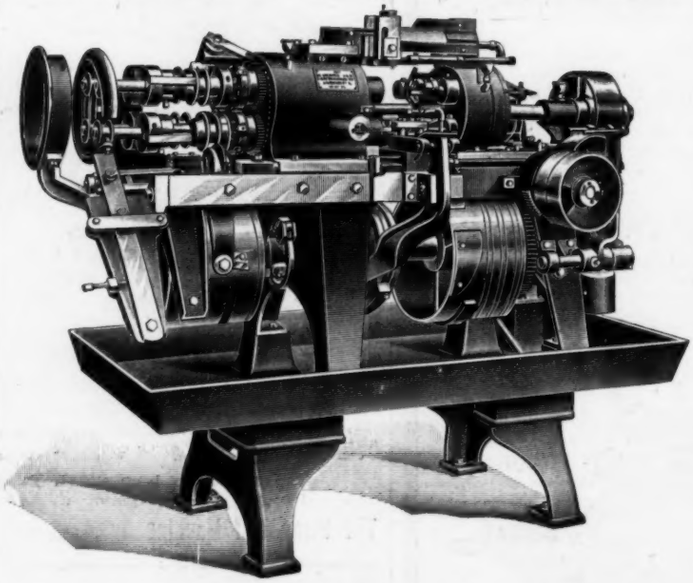
Competition Demands That You Install an Acme Automatic, the Four-Spindle Wholesale Screw Machine.



You can't compete with a single-spindle machine doing only about one-fourth the work.

The "Acme" Produces Four Finished Pieces at Every Full Turn of the Cylinder.

The provision whereby all tools (only one set) act simultaneously, working on four bars or rods at a time, makes the "Acme" superior to any other automatic that human ingenuity has contrived. It has all the modern approved features essential to operating convenience and accurate product.

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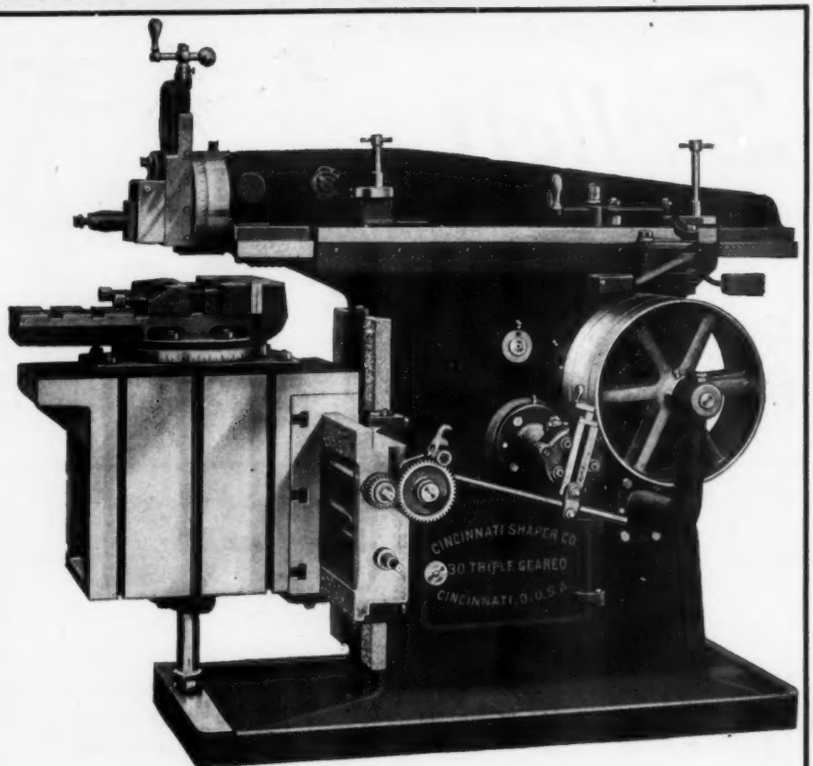

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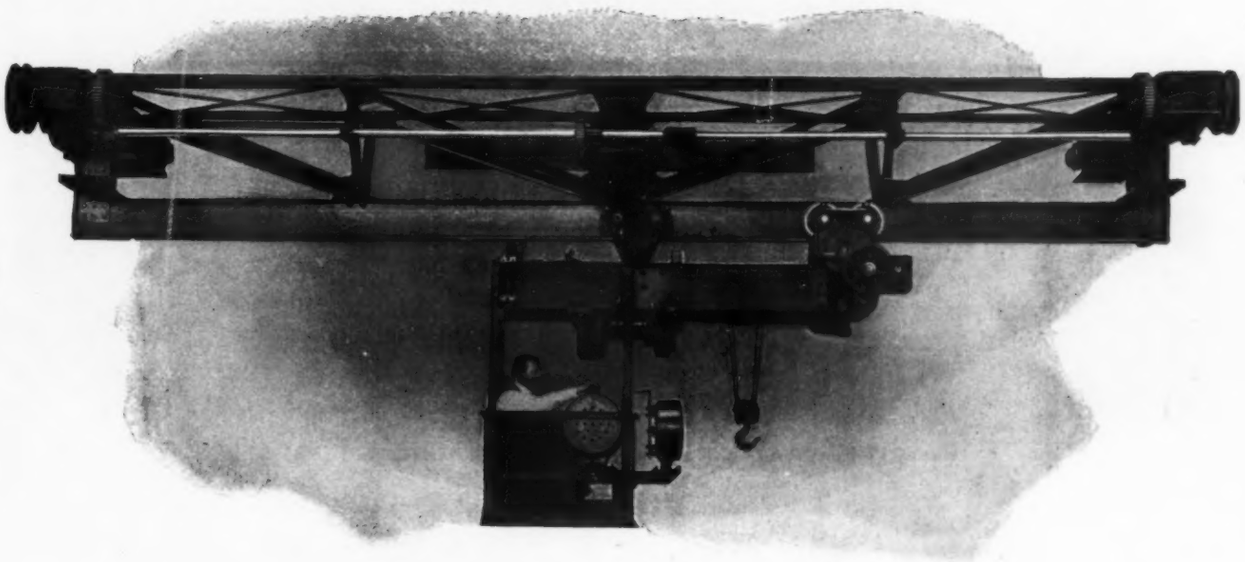

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A crane trolley which can run off its bridge and carry its load to any point of an extensive plant is the essential feature of our new system of crane service. The trolley runs on a single I beam track. The operator's cage is attached to the trolley so that the operator accompanies the load on its travels.

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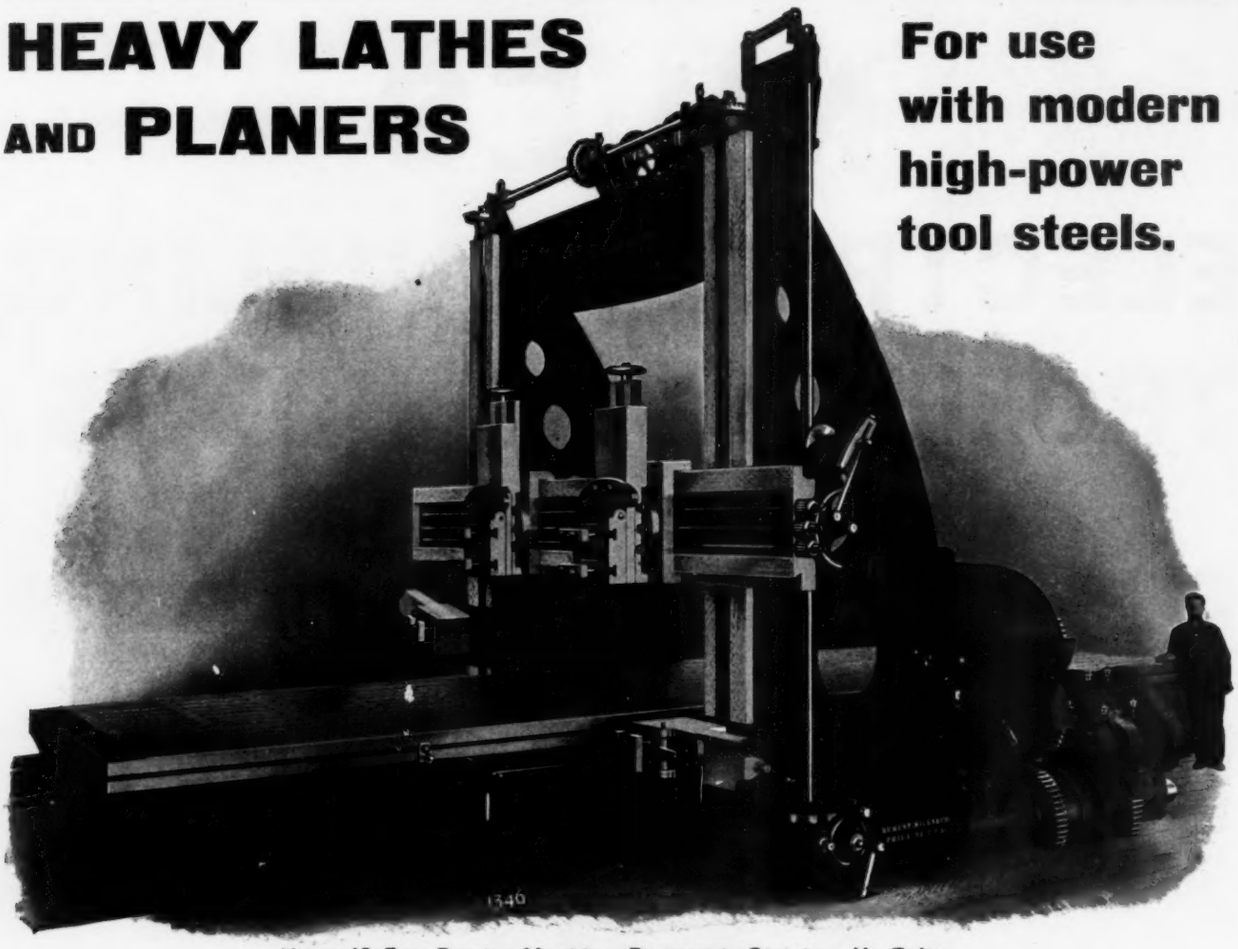
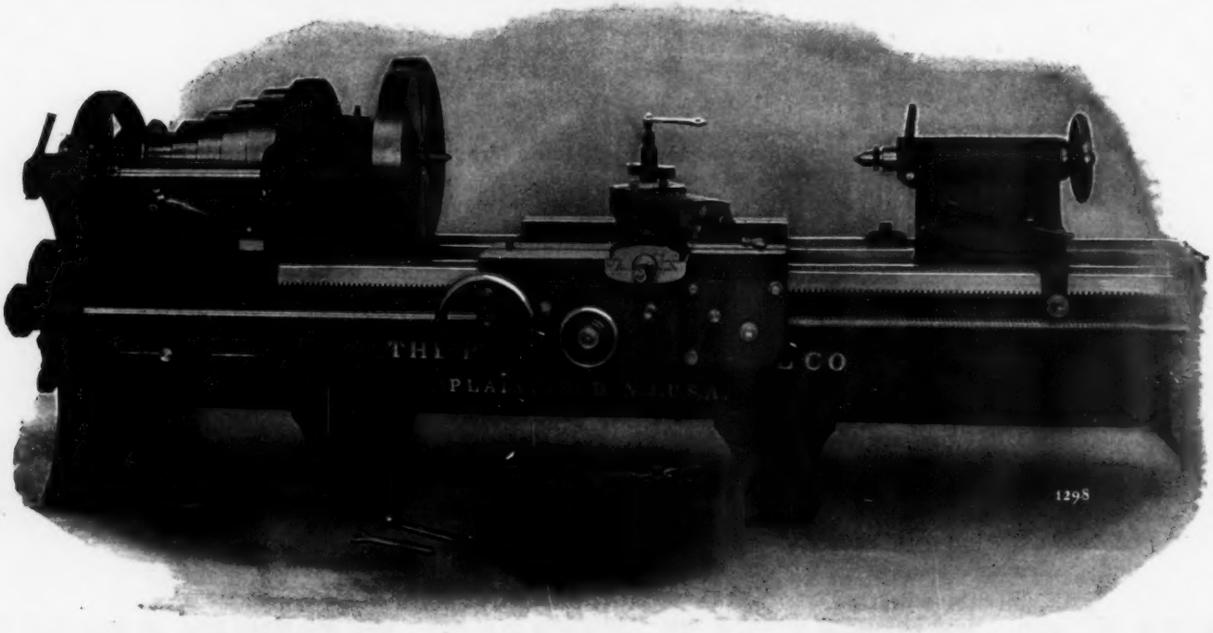
For use with modern high-power tool steels.



Heavy 10-Foot Planing Machine, Pneumatic Clutches, No Belts.



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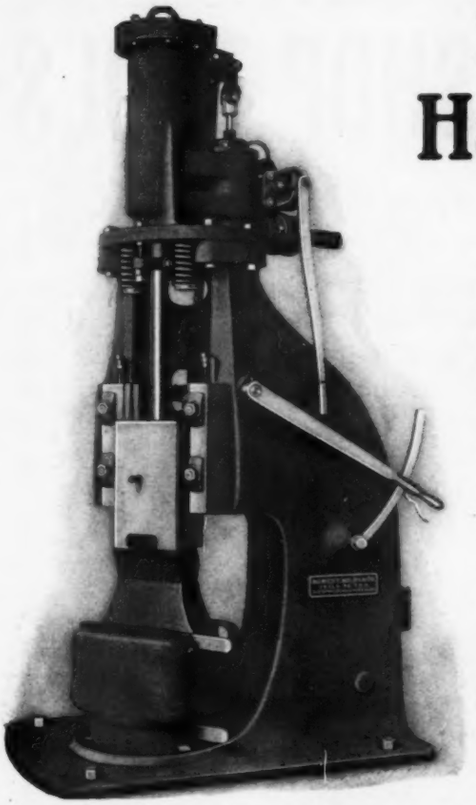
Steam Hammers



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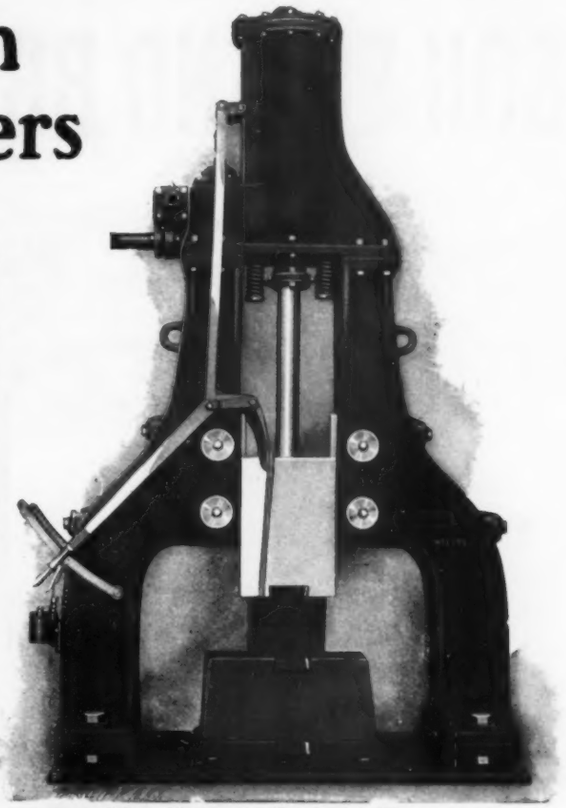
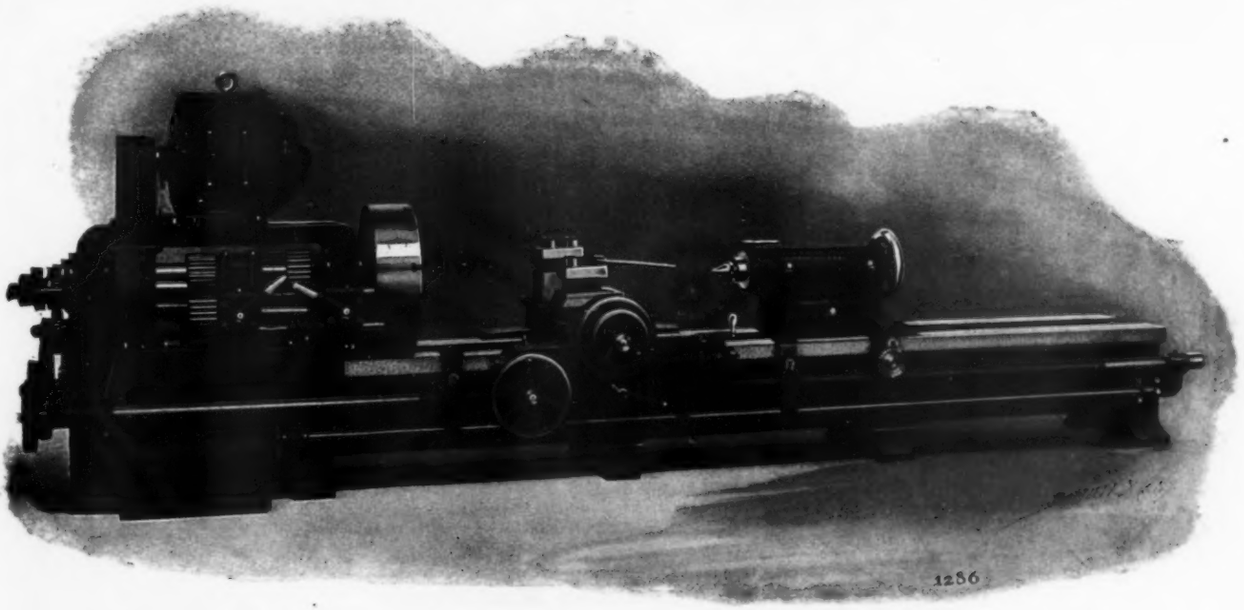


Double Frame Steam Hammer.



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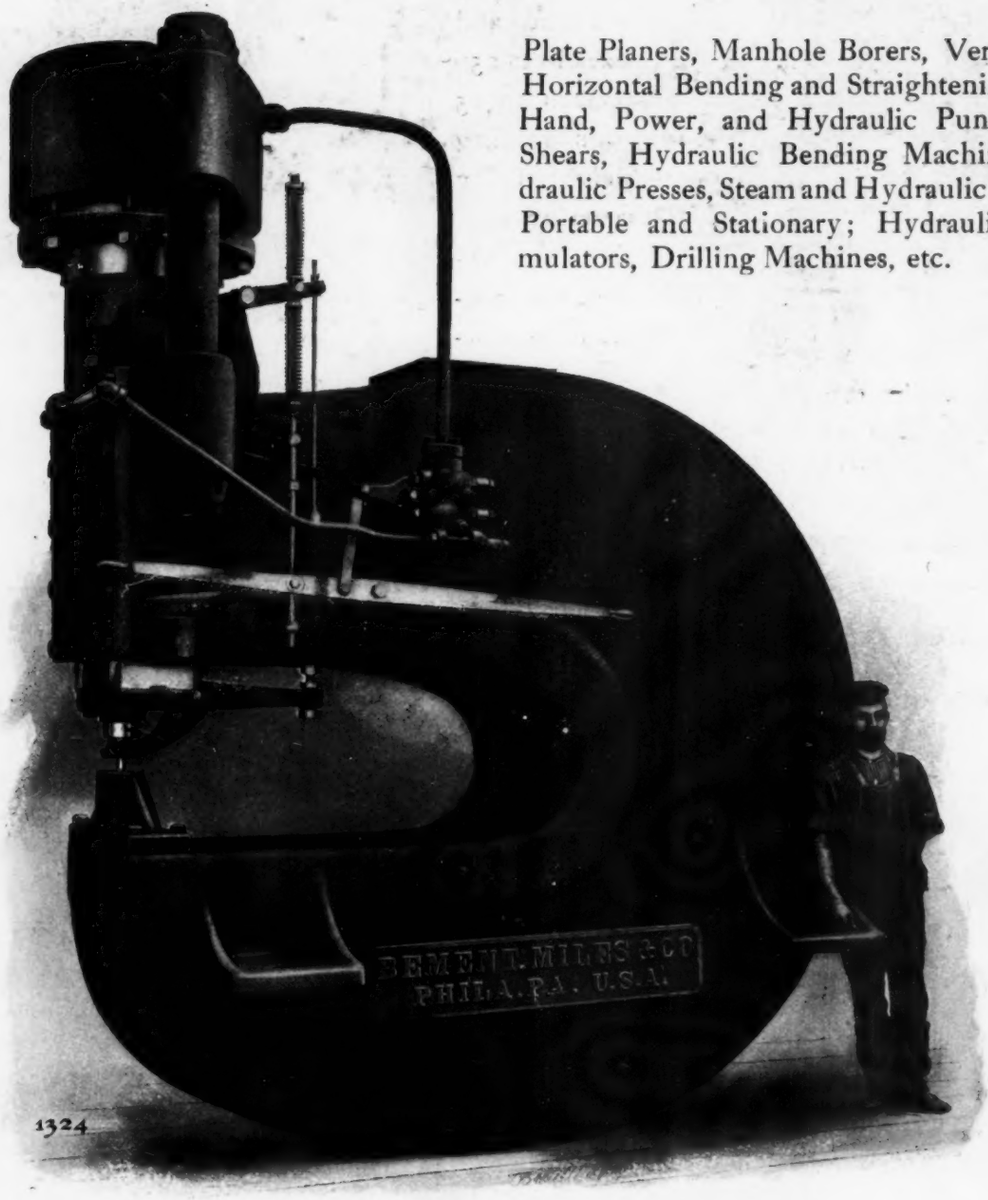

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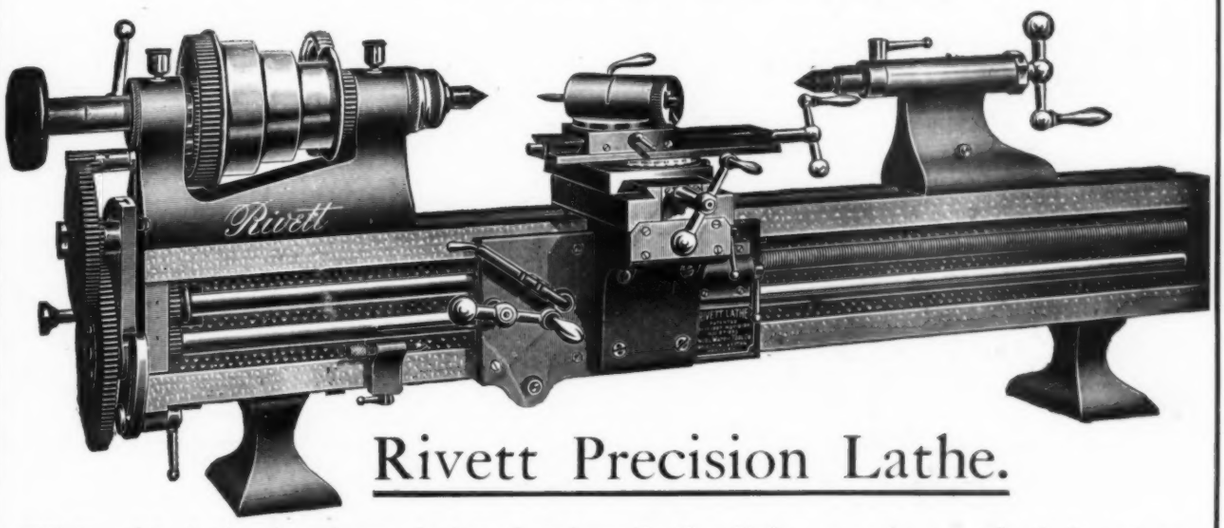

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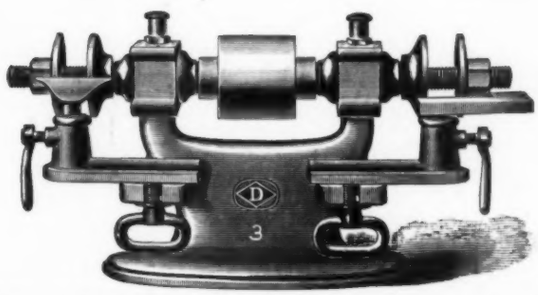

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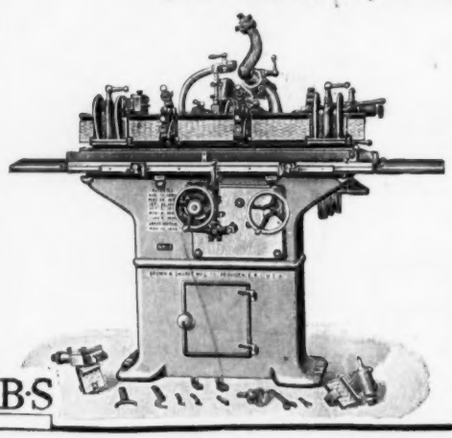

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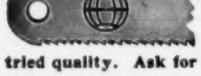

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